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Several areas are discussed including--(1) architectural criteria, (2) installation and operation of public entrance doors, (3) weather protection, (4) materials and maintenance factors, (5) coordinating hardware for entrance doors, and (6) open forum discussion. Six factors are cited as being critical in the design of public doorways--(1) the need for a complete study of the entrance doorway in order to minimize physical problems, (2) consideration of the building's function and the usage of the specific doorway in the design and selection of materials, (3) the need to provide security against unauthorized entry, (4) durability of the entire assembly, (5) operation of the doorway should be obvious, simple and free from potential accidential hazards, and (6) the budget assigned must be adequate to provide satisfactory design and installation of quality entrances in public facilities. (RH)

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# PUBLIC ENTRANCE DOORS

National Academy of Sciences—
National Research Council
publication 948

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# PUBLIC ENTRANCE DOORS

Proceedings of a Conference
presented as part of the 1961 Spring Conferences
of the
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Division of Engineering and Industrial Research

Publication 948

NATIONAL ACADEMY OF SCIENCES—NATIONAL RESEARCH COUNCIL
Washington, D.C.
1961

The Building Research Institute gratefully acknowledges the contributions to building science made by the participants in this conference.

Milton C. Coon Jr.
MILTON C. COON, JR.
BRI Executive Director

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# Abstracts of Conference Papers

## ARCHITECTURAL CRITERIA FOR PUBLIC ENTRANCE DOORS

By Gustave R. Keane, Eggers and Higgins, Architects

Seven design criteria used by the architect in locating, designing or selecting an entrance doorway are discussed separately and in detail. These are: the function of the building; ingress and egress capacities; the importance of the entrance as an aesthetic design element; safety and ease of operation of the doors under all loading conditions; security against unauthorized entry; maintenance requirements and weather resistance; and budget considerations. There is also included a check list of 21 points which the architect uses to determine the suitability of his preliminary selection. Development of quality standards for various types of installations, standardized tests which would demonstrate quality, a laboratory to which manufacturers could submit their products for unbiased testing, and cooperation with the hardware industry in the development of standards and installation dimensions for hardware items are all strongly urged. As regards future product development, the author lists eleven areas for further research and development on both doors and hardware.

* * * * * * * * * * *

## INSTALLATION AND OPERATION OF PUBLIC ENTRANCE DOORS

By Ralph E. Andrews, The Alumiline Corporation

This paper considers criteria essential to keeping quality standards for public entrance doors in accord with the architect's intent, and to achieving maximum life expectancy for the doors themselves. Problems now encountered, which could be avoided with proper design and planning of the doors are discussed, particularly with respect to minimizing accidents to the general public. Improper use of hardware which hampers operation and damages doors is also noted, and the location of doors with proper consideration of their operation and maintenance. A number of common problems which could be avoided by more careful installation are mentioned.

* * * * * * * * * * *

## WEATHER PROTECTION OF PUBLIC ENTRANCE DOORS

By F. L. Maddison, A. B. Maddison Co., Inc.

This paper discusses weather protection of public entranceways in terms of: the proper kind of weatherstripping for use with doors of various materials, and its correct installation; five considerations in the use of caulking and sealant materials; utilizing the threshold as a means of weather protection; establishment of correct door clearances; and the effect of the location of public entrance doors on good weather protection of the building lobby and interior. The author recommends careful study of the orientation of the building, prevailing winds, pedestrian traffic, the location in relation to the doors of interior exhaust systems, and the use, wherever possible, of doors set back from the exterior walls, rather than in line with them.

* * * * * * * * * * *

## MATERIALS AND MAINTENANCE FACTORS FOR PUBLIC ENTRANCE DOORS

By Edward H. Stein, Pittsburgh Plate Glass Co.

The types of finishes available, the proper protective coatings, and the best methods of cleaning and preservation of the finish of aluminum, bronze, stainless steel and wood doors are presented. Protection of glass during construction, its storage at the site, and the possible repairs of surface damage are detailed, with a warning about the effect of some types of so-called protection which can actually damage the glass. Recommended steps in the operational maintenance of doors, frames and thresholds, sidelights and transom glass, door accessories, manual checking hinges and closers, and automatic door openers are discussed.

* * * * * * * * * * *

## COORDINATING HARDWARE FOR ENTRANCE DOORS

By J. E. O'Keefe, Builders Hardware, Inc.

Information presented in this paper is confined to doors and hardware used in such buildings as schools, hospitals, office buildings, churches and manufacturing plants. The role of the hardware distributor in the selection and subsequent delivery of the hardware to the building site is explained, demonstrating that he is often the key to proper selection of appropriate hardware items. Stating that coordination of hardware with wood, tempered glass, stainless steel, bronze or wrought iron doors is being successfully accomplished, the author then describes some of the problems encountered by architects, contractors and building owners in connection with hardware used on aluminum entrance doors. Lack of cooperation and understanding between the hardware distributors and the aluminum door distributors is cited as the basic cause for these problems. Steps to be taken to overcome this difficulty are enumerated.

# DISCUSSION PANEL FOR THE CONFERENCE

Moderator - William S. Haswell, Managing Director
National Builders' Hardware Association

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EDITOR'S NOTE: Short panel discussions were held following each speaker's paper, and these are included as part of the particular paper. The panel members above and all the speakers acted as discussants for the individual papers and also for the Open Forum Discussion held at the end of the Conference.

# Architectural Criteria for Public Entrance Doors

By Gustave R. Keane,* Production Administrator,
Eggers and Higgins, Architects

## DESIGN CRITERIA

Listed below are the seven design criteria used by the architect in locating, designing or selecting an entrance doorway. Each criterion is discussed in further detail under its own heading.

1) Function of the building.
2) Ingress and egress capacities.
3) Importance of the entrance as an aesthetic design element.
4) Safety and ease of operation under all loading conditions.
5) Security against unauthorized entry.
6) Maintenance requirements and weather tightness.
7) Budget considerations.

### Function of the Building

Enumerated below are eight types of buildings listed in descending order of peak load concentrations:

1) Legitimate theaters, assembly halls, race tracks.
2) Multitenant office buildings, department stores.
3) Single tenant office buildings.
4) Public schools.
5) Transportation terminals.
6) Churches.
7) Hotels, apartment houses, hospitals.
8) Libraries, banks.

Through its function, each of these building types presents a different problem as far as public entrances are concerned. For instance, the entrance to a theater or assembly hall will be subjected to a maximum concentrated peak load at the beginning and end of each performance, while banks and libraries are subjected to more or less constant loading throughout the day. Single tenant office buildings and, to some extent, schools will experience a number of peak loads at controlled intervals.

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*GUSTAVE R. KEANE, Educated as an architect-engineer at the University of Czechoslovakia; Member, American Institute of Architects, Building Research Institute, ASTM.

Similarly, the function of the building will also determine to a large extent the importance of the entranceway as a design element. This factor will be more fully treated under the third criterion, but is kept in mind by the designer as he considers the second criterion.

## Ingress and Egress Capacities

Egress requirements are governed by one or more of the following codes, regulations or recommendations:

| Name of Publication | Issuing Authority |
|---|---|
| Local Building Code | Municipal Government |
| State Building Code | State Government |
| National Building Code | National Board of Fire Underwriters |
| Building Exits Code | National Fire Protection Association |
| Basic Building Code | Building Officials Conference of America |
| Uniform Building Code | International Conference of Building Officials |
| The Standard Building Code | Southern Building Code Congress |
| Midwest Building Code | Midwest Building Officials Conference |
| Labor Laws | Federal and State Government |
| Public Health Laws | Federal Government |

In fulfilling the requirements of the appropriate codes, the architect will remember that the prescribed standards are minimum standards, and will use his judgment and experience in order to prevent loss, tragedy or inconvenience. For instance, most codes require that fire stair towers be provided for the occupants of a building to exit directly to the street, thereby eliminating the congestion at the lobby entrances. It might seem from the code provisions that the egress capacity of the lobby could be safely reduced, since the bulk of the occupants would presumably use the stairs without passing through the lobby. Consider, however, the pandemonium that would result if elevators continued to function during an emergency, and all occupants were suddenly emptied into the lobby without adequate means of emptying quickly into the street. Therefore, the maximum exit facilities should always be provided through the usual paths of ingress and egress, regardless of emergency facilities.

## Importance of the Entrance as an Aesthetic Design Element

With the required number and sizes of entrance door units established by computation plus judgment, as described in criterion No. 2, the architect will return to consideration of the function of the building in order to solve criterion No. 3, namely aesthetic design. The appearance of the entrance will naturally have to harmonize with the style of the building, but degrees of emphasis or de-emphasis will come into play.

For instance, while the secondary entrance to a church building will be deliberately de-emphasized, the secondary entrance to a department store will be played up to the hilt, and made just as inviting as possible. Main entrances to all types of buildings are given sufficient importance to make them obvious at first glance, and inviting to enter.

## Safety and Ease of Operation During all Loadings

This criterion is divided into subcriteria as follows:

1) Fire and panic operating situations—The safety potential of an entranceway starts with its strategic location within the building plan. The flow of traffic, especially during panic situations, must be given particular consideration with special emphasis placed on smoothness of flow without pockets or eddies. For these reasons, the entranceway should preferably be in a direct line with the main banks of elevators or other concentrations of occupants. It should be easily identifiable as an exit by its location and choice of materials, rather than by reliance on a series of directional signs, and it should terminate in a location where the occupants will be able to disperse quickly without interfering with existing sidewalk traffic.

   Panic exit devices should be substantial and should extend across the entire opening, even if this means a slight compromise with the design concept. They should be properly labeled and approved by the Underwriters' Laboratories as accident equipment.

2) Accident prevention in normal use—Depending on the climate, the height of the building and the use of the lobby, the decision will be made whether to use double banks of entranceways with a shallow vestibule-windcatcher between them, or a single bank of entrance doors with or without revolving doors. Modern motor-driven revolving doors are run at a maximum speed of 12 rpm, which has been found quite safe even for elderly people. At that speed they will allow 2880 people per hour to enter, and the same number to exit simultaneously without interfering with one another. The revolving door also has another advantage in that it creates its own traffic lane pattern, which continues for a considerable distance into the lobby.

   A vestibule-windcatcher should extend in depth a minimum of three times the width of the doors leading into it. Anything below that figure will prove unsatisfactory as it will create interference among the users. The latitude for choice of the entranceway is quite considerable and ranges from the completely unobstructed opening provided by an air curtain installation, used perhaps at a transportation terminal building, to the wicket door cut into a large church entrance door.

   There is another reason why main entrances should preferably be recessed from the building line. It is often desirable to create a loggia of some 15' to 20' in depth extending over considerable width, in order to create a covered forecourt from which the occupants can smoothly join the existing sidewalk traffic. Apart from shielding the doors from the weather, the recessed entrance is also useful in reducing the hazards of slipping due to wet or icy pavements, because the entrance provides a transition surface between the dry lobby and the wet or icy sidewalk.

   One frequently neglected safety aspect is proper lighting. This becomes especially critical with the use of frameless glass and side lights. Citing three most common examples of accident hazards:

a) A visitor, trying to enter a dimly lit lobby from the sunlighted outdoors, will not see an occupant leaving and swinging the door toward him. Remedy: Increase level of illumination in lobby.

b) An occupant walking and looking from the lobby toward the bright outdoors will not see the glass, and walk right into it. Remedy: Bounce a spotlight off the interior surface of the glass.

c) A visitor during hours of darkness, walking from the sidewalk through a recessed loggia toward a brightly lit lobby, will fail to see the glass. Remedy: Focus a light about 4' ahead of the door; the visitor will then see his reflection in the door.

While thinking about the safety of the occupants, the architect will also consider the use of safety glass. According to the magazine, "The Pacific Architect and Builder," there occur in buildings an average of 40,000 serious accidents per year due to people walking or falling against glass. Safety glass is produced by inserting a sheet of highly adhesive, tough plastic as a membrane between two outer layers of glass, creating a crash-resistant sandwich. Safety glass has been used successfully in automobile windshields for many years. The membrane can be colored or designed with decorative motifs, and thereby may prevent people from walking into the glass.

3) Ease and convenience of normal operation—The next step will be to decide on the type of door operation itself; whether manual, semi-automatic as revolving doors or hand-triggered devices, or fully automatic motor-driven doors triggered by pressure or photoelectric cells. Hardware chosen must be coordinated with the manufacturer of the doors to assure sufficient room for mounting it without weakening the frames and stiles beyond the limits of safety.

## Security against Unauthorized Entry

The architect will again refer to criterion No. 1, the function of the building, in this connection. Many transportation terminals remain open 24 hours a day, seven days a week, and locks therefore become superfluous. In many city office buildings security is a minor factor because lobbies are designed in such a way that all doors leading from them to stairs, elevators and basements are locked from the lobby side, and an unauthorized person entering through the main entrance after hours is faced by the lobby watchman.

Most office building entrances in New York City remain unlocked all night and are locked only on Sundays; therefore, good quality cylinder locks of average complexity will suffice for these applications. Moreover, in large cities many buildings are protected by the installation of alarm systems and/or the employment of private protection agencies.

Public entrance doors for all other buildings will be designed with emphasis on keeping unauthorized persons out. Cylinder locks will be selected to withstand the best efforts of the superior lock-artist and the door itself will be made stiff enough to withstand jimmying. The panic devices must be selected and placed in a way which will make it impossible to operate them by means of a hooked wire from the outside; this applies particularly to pairs of doors mounted without mullions or astragals. If astragals on double doors are used, the coordination must be foolproof, so that the doors will positively lock every time.

Dead bolts in an inactive door should have a positive locking feature. If only the top one locks, it becomes possible to rack some doors and spring the latch back on the active door. When at all possible, public entrance doors should be locked both top and bottom. This rule is borne out by the great number of broken glass and racked metal-glass doors which have resulted through reliance either on top or bottom locks only, and testifies to the obstinacy of the general public. Door hardware using emblems and other decorative items that could be attractive to vandals and souvenir-seekers should be secured by concealed, tamper-proof fasteners.

While we are on the subject of security, the desirable locking of stair doors in multiple-tenant buildings has always presented a problem because of local building codes. If one tenant occupies two or more successive floors in a multistory building, it is to his convenience to use the stairs; at the same time he does not want entry by other tenants to his floors. This can be solved by providing a double cylinder lock with a special stair control key. Ready egress is retained at all times, as the stair-side knob will operate the latch regardless of the position of the cylinders. The function of the corridor-side cylinder is to control the operation of the stair-side knob; if locked, access from the stair is by key only. This key retracts the latch without moving or unlocking the stair-side knob, therefore the security against unauthorized entry remains unimpaired after use. The stair-side key cannot unlock the corridor-side cylinder and thereby change the setting; this can be accomplished only by the special control key. This system controls the authorized traffic between floors and simultaneously prevents the "setting up" of the stair doors for unauthorized entry after hours.

## Maintenance

The safe operation of the entire entranceway assembly is jeopardized if the mechanical parts are not properly maintained. This seems obvious on a fully automatic door installation, but it applies equally well even to the simple, manual door. If, for instance, the threshold pocket for the actuating bolt is not kept clear, and therefore only the top of the door is kept in place, very soon somebody will force the door out of alignment and it will never close properly from then on. Improperly maintained panic exit devices will fail to latch automatically. The result is loss of security, or worse, a door which jams during an emergency.

Glazing should be checked for looseness; if looseness is found, it should be immediately corrected. Otherwise, rattles will develop and, eventually, cracking or breaking may occur. The maintenance workers should also be instructed to remove the usual "Use next door, please" sign during rush hours, so that traffic will distribute itself through all available doors.

Future maintenance of finishes would be greatly reduced if the finish and its lacquer coating were properly protected during the construction of the building. An article in the January 1961 issue of "The Hardware Consultant" suggests mothballing the finished surfaces of hardware items with a pressure sensitive cover applied at the factory, which would stay on through shipment, handling, installation, plastering and painting, until just before the building is occupied. This would prevent most scratches caused by the various mechanics and clean-up laborers.

## Budget Considerations

The entranceway is the first and last part of the building which a visitor sees and uses. Considering this fact, and even more important, the architect's responsibility for safe design, the budget for the entranceway should have a highly preferential status. Aesthetics will dictate design and materials; however, the strength of the frames and the quality of the moving parts must never be compromised for budgetary reasons.

## CHECK LIST

The architect will check his preliminary selection against the following points:

1) Will the door accommodate the traffic flow smoothly during peak or panic loads?
2) Will it do the same during normal loads? Will two users approaching it from opposite sides interfere with one another?
3) Is there a possibility that a user may injure himself by mistaking a fixed side panel for a door? Would the use of laminated safety glass be advisable, perhaps with a colored or decorative membrane?
4) What provisions are made to prevent in-going and out-going persons from colliding with one another or from being struck by the door?
5) Can the out-swinging door injure a pedestrian walking along the side of the building?
6) Is illumination of lobby and loggia designed to prevent accidents?
7) On automatic doors, what provisions are made for safe and easy manual operation in case of sudden mechanical breakdown?
8) If overlapping astragals are used on a pair of doors, what type of coordinator can be incorporated in the design? The right-hand leaf as viewed from direction of egress must be the active door.
9) Can the speed of the closing device be properly controlled?
10) Will stack effect or wind pressure on the door prevent its easy operation? What provisions are made to overcome different wind loadings, so that even the proverbial little old lady won't have to find a helpful Boy Scout to open the door?
11) Does the design of the stiles and rails permit application of substantial reinforcing and hardware?
12) Is adequately heavy jamb and head reinforcement provided which will prevent stripping of screw threads and sagging, causing the door to jam when least permissible? (In the last few months a new design of hinge was brought out which is mounted at the very head of the door and consists of a combination butt hinge with a heavy pivot hinge incorporated at the top. The butt part is mounted as usual, and the pivot is recessed into the frame head and door head for about 8". The steel pivot then takes all the forces from the overhead door holder in shear, leaving the butts to carry the weight of the door only. This seems a worthwhile improvement.)
13) If a floor hinge type of door holder is provided, is it located so that it cannot be tripped accidently by one user, causing the door to strike a person closely following?
14) Is threshold raised to clear obstructions and unevenness of sweep area, and does it feather out to surrounding finishes? What nonslip provisions are made? Will the dead bolt socket catch ladies' heels?
15) Is the mat sinkage drained so that accumulation of snow and slush on it won't interfere with the swing of the door?
16) What are the provisions made at the jambs to prevent injuries to children's exploring fingers?
17) Is construction of frames and doors substantial enough to stand up in prolonged use without racking and eventual glass breakage?

18) In a bank of doors, will door holders positively prevent protruding door pulls from being struck by the adjoining door? This may seem elementary, but it has happened because most door holders will hold a door at 90°, but first permit it to open to about 97°.

19) Is there an adjustable speed governor fitted to the revolving door to prevent "heel-snapping"?

20) Is the design of the push bars sufficiently asymmetrical to make the latch side of the door obvious to a visitor?

21) Will the assembly be weathertight?

## RECOMMENDATIONS

### To the Architect

While selecting the entrance doorway in accordance with the criteria outlined on the preceding pages, draw freely on the advice and experience of a reputable manufacturer or erector, and a hardware consultant. They specialize in this field and have, therefore, accumulated the practical experience to help carry out your design concept within the limitations of the materials and in accordance with safety requirements.

Do not skimp on the budget! The entranceway is the first and the last part of the building with which every occupant or visitor literally comes in contact. Shoddy appearance or unsatisfactory operation will leave a most undesirable impression.

Insist on delivery of the specified make and type of entrance. Be wary of substitutions; they rarely are an equal to the specified article and almost never an improvement.

Insist on early submission of shop drawings so that any misunderstandings concerning the make or the quality are cleared well before the article is required for the orderly progress of the project.

If at all possible, avoid the use of double-acting doors in pairs. These account for the largest percentage of door accidents, both to children and grown-ups.

When using double-acting single doors, be especially aware of lighting conditions in the lobby and vestibule.

To achieve better control and single responsibility, specify the entranceway as a complete package including subframes, frames, doors, operators, closers, holders and guide rails, hardware and glazing. However, retain control over the quality of the products, especially hardware, either by checking the individual components used by the manufacturer before specifying the package or by designating each component part of the package separately. In the latter instance, the hardware consultant will prove helpful as he can best advise which products will fit the various entrance frames.

### To the General Contractor

Subcontract the entranceways early, and with them, if they are specified separately, the contiguous subcontracts such as structural subframes, hardware and glazing.

Check shop drawings thoroughly and coordinate all trades so that there will be no conflict between entranceway as shown on shop drawings and the actual field conditions.

Entranceways nowadays are manufactured to very close tolerances, and even minor discrepancies of opening plumbness or inside and outside floor heights are difficult to overcome because there is very little take-up left.

### To Manufacturers' Associations

Develop a series of quality standards for various types of installations. These standards should state gauge, thickness, stiffness of sections, joint construction, racking resistance, expansion and fatigue factors, glazing recommendations and other pertinent data.

Develop standard tests, similar to the widely accepted tests on windows and curtain walls, which would demonstrate the above qualities.

Organize a laboratory to which the manufacturer could submit his product for testing and from which he would obtain a certificate testifying to the product's compliance with the standards.

Cooperate with other hardware trade associations in developing standards and installation dimensions for hardware items used in entrance doorways.

### To the Manufacturer

Send only thoroughly trained architectural representatives into architects' offices. Each man should be completely familiar with his product and all its applications, and with contiguous items relating to these products.

Publish complete engineering data on your product including wind load tables, racking resistance, and other factors described above as desirable to be covered by the standard association test.

Cooperate with the associations in devising quality standards and tests. After establishment of those standards, grade and mark your products accordingly.

Initiate research and development by your association of standardized outside (installation) dimensions of hardware items to allow interchangeability of various makes of locks, etc., within the same door cutouts.

Furnish your first-line product only to approved erectors, whose mechanics have taken a factory training course.

Furnish a maintenance manual which describes a systematic maintenance program for all moving parts and finishes.

Protect your finishes during installation and painting operations by applying a pressure sensitive, removable cover at the factory.

### To the Erector

Install the assembly in strict accordance with the manufacturers' instructions and details. Have your superintendent take factory training.

Offer a complete package installation as described under Recommendations to the Architect, above.

## To the Owner

Institute a systematic maintenance program for the servicing of entrance doorways similar to those accepted for other mechanical devices such as elevators, roof fans or pumps.

Do not skimp on the budget!

## On Product Development

1) Develop fadeproof color finishes, much more abrasion resistant and easier to maintain. This applies particularly to aluminum.

2) Standardize installation dimensions of hardware items to permit interchangeability of chosen items among the various manufacturers' products.

3) Improve door closers so that they are self-adjusting to compensate for back pressure due to external wind loads or varying stack effects.

4) Develop closers or floor checks with automatic stopping or override devices (similar to elevator doors).

5) Provide for easier adjustability of butts, pivot and threshold to compensate for movement due to initial shake-down period of building.

6) Eliminate accident hazard at jamb due to space created by offset pivots.

7) Develop simultaneously-operating dead bolts for inactive leaf of double door to prevent the possibility of leaving one dead bolt open.

8) Develop a better coordinator or other mechanism to close astragal-equipped double doors in proper sequence. Astragals are very desirable, but can be used only rarely because of lack of proper coordination.

9) Improve weather stripping, especially as it applies to center-pivoted doors.

10) Incorporate a pocket in the jamb or sill to contain the adjusting tools for the entranceway. The ready availability of the tools would be conducive to much better maintenance and more frequent adjustment.

11) Include the hardware with the entrance doorway package.

This last recommendation will undoubtedly draw objections from the hardware industry, and I agree that some of the objections are justified; for instance, the necessity for occasionally bastardizing the locksets if a master key system is required. However, from the owner's, the architect's and the general contractor's viewpoint, this fault presents the lesser evil as this method permits placing single responsibility for the proper operation of the entire entrance doorway assembly in one subcontract.

Architects and general contractors have found themselves too many times in the center of a dispute between the door frame manufacturer, the erector and the hardware supplier, with each blaming the other for improper operation of the entire assembly. To quote just one actual case from our experience: A large aluminum and glass entrance door sagged at the lock stile which made it bind at the top and rub at the threshold, and the latches did not function properly. The architect directed the general contractor to fix it. (This happened during the guarantee period.) The general contractor called the erector, the hardware supplier, the hardware manufacturer and the frame manufacturer. A few weeks passed and then the following argument developed and was passed on to the architect for his decision:

1) The erector claimed that instead of the 4-1/2" butts specified and installed, butts should have been 5" extra heavy duty. He claimed that the top hinge must have opened up and therefore let the door sag. Therefore, this was not his problem.

2) The hardware supplier and the hardware manufacturer sent the hinge to the factory where it was measured, analyzed and attested as being within the tolerances for a new hinge. They, therefore, disclaimed responsibility and suggested as the real culprit the frame manufacturer, who, they claimed, installed insufficiently heavy reinforcing and whose jamb section was of too light a gauge. This, they claimed, permitted the jambs to take on a permanent warp at the top under an excess load.

3) The frame manufacturer attested that he had used the same reinforcing and jamb section in hundreds of installations without a single failure. He suggested that if the erector and hardware manufacturer were right in their analysis, and since he was absolutely sure of his own product, the fault lay with the general contractor who, he claimed, failed to install the jamb anchors with sufficient rigidity and also did not properly back up the jamb with masonry for its entire length.

4) The general contractor disclaimed any fault, threw up his hands and passed the whole mess on to the architect, claiming that obviously the specifications were not right.

This whole argument could have been avoided with single-package responsibility. There is one other way to avoid similar conflicts and simultaneously gain the advantages of keeping the finish hardware with the remainder of the building hardware. It requires implementation of two recommendations made to the manufacturers' associations in this paper. If, for instance, an attested quality standard existed which would specify the gauge thickness, reinforcing, size and weight of butts and installation details for a given use, then this whole argument would have been avoided because this failure would not have occurred.

The second requirement for keeping the exterior hardware with the remainder of the building hardware is the development and adoption of standardized outside installation dimensions for entrance door hardware. The entire hardware contract is most frequently bid separately, usually several weeks or even months after the general contract is awarded. The bidding is opened not only to several suppliers of one manufacturer's product but frequently to suppliers of several different manufacturers. Therefore, in the absence of definite assurance that all the bidders' products will fit the selected door assembly, the architect must play it safe and exclude the exterior hardware from the rest, and instead have it furnished by the door manufacturer, to make sure that it will fit.

The architect would much prefer to keep all hardware in one contract but, before he can do that, he needs these definite safeguards.

## PANEL DISCUSSION*

Mr. Murphy: In a large office building, is there any recognized design relationship between the capacity of the entrance doors to admit people in the lobby and the capacity of the elevators in the building to take them to the upper floors?

Mr. Keane: There is a very definite relationship. It depends on the speed of the elevators, the number of elevators, and also the control of the building. In a rental office building consisting of a great number of small offices, you cannot control traffic, so you have to increase the capacity both of the entrance doors and the elevators. In a single occupancy type of office building, except for large corporations where control is difficult, it can be reduced to a certain extent.

Mr. Murphy: The major problems occur in single occupancy buildings, where the expected arrival traffic could be on the order of 20% of the occupancy within 5 minutes of the reporting hour. Obviously, the entrance door's capacity must be greater than that. One way of controlling the entrance traffic, and balancing the arrival of people into the lobby with the capacity of elevators, is to limit them by means of the entrance doors. If the elevator capacity is 100%, should entrance door capacity be, perhaps, 125%, or should it be 75%?

Mr. Keane: The entrance door capacity should probably be 125% rather than 75%. In other words, you analyze occupancy, time of arrival, the concentration of arrival, and solve the problem of elevators first. Then you solve, depending on the size of the lobby, the problem of entrance doors. The size of the lobby determines how many people can enter before the discharge into the elevators begins.

Mr. Chapman: Mr. Keane, would you care to elaborate on the criteria that the architect uses in determining the type of door selected? I refer to single-bank swinging doors, vestibule-type swinging doors, revolving doors, etc.

Mr. Keane: If you had a single occupancy office building with only one tenant and you decided to have the lobby designed as a reception room, which is sometimes done in large decentralized corporation offices, you would automatically have to provide sufficient comfort in that lobby. This would mean revolving doors, plus vestibule doors, since the receptionist is sitting right in the lobby or waiting room. That is the most critical of all the entrance lobbies. In the normal New York City office building, in which you have just the elevator starter, and banks of elevators that are automatic, all you need to worry about is the elevator starter, who is usually warmly dressed. Then, you might have double bank vestibule doors. You also will be guided somewhat by stack effect. If the building is very tall, you will get a considerable draft from the stair wells sucking air out of the lobby. In turn, that would make it more difficult to open the doors to the outside. Therefore, you might be tempted to put two banks of entrance doors in, and create an air chamber between them. A double bank of entrance doorways is also preferable sometimes because you can overheat the space between them. You can heat the space to about 90 degrees, and conversely cool the space way down in the summer, so that by the time you get into the lobby you have a mixture of the cold outside air and the overheated air coming back to about normal in the lobby, and vice versa in the summer. There are many kinds of criteria used to work this problem out.

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*Members of Discussion Panel listed on page vii.

Mr. Wright: You mentioned that in your judgment the entrance doors should be a package unit—a centralized responsibility. I can agree with that to a certain point, but do you think it would be acceptable for an architect to have the hardware for the entrance doors furnished under the hardware contract, possibly shipped to the door manufacturer's plant and installed by him on the doors at his plant?

Mr. Keane: I have no objection to that. I wouldn't say that I would prefer to have a package forever, but as conditions are at this time it is preferable. When we specify an entrance door and hardware, and we know the hardware will fit the particular entrance door, that's fine. However, three months later the contractor may come back with a substitution either for the entrance door or the hardware, and suddenly the two don't fit any more.

Mr. Wright: I understood you to say that architects do not accept substitutions.

Mr. Keane: I recommend that he doesn't accept substitutions, but sometimes he can't help it.

Mr. Stein: Mr. Keane made a statement with reference to 40,000 injuries as a result of glass breakage, etc. on doors. I would like to state that this figure, first of all, has been quoted out of context and further, that this particular figure was used in a very broad sense. It was an approximation by one individual on the West Coast. He has admitted that it was an approximation, and also that the 40,000 figure refers to almost every type of glass door that you can think of, including low cost sliding doors, bathroom sliding doors, and probably even sliding closet doors. I have no axe to grind in saying that the figure has been poorly used, but I hope that all concerned will realize that it is not a very good figure as applied to public safety.

Mr. Haswell: Mr. Keane, do you wish to say something in rebuttal?

Mr. Keane: The text of my paper said that according to the magazine, and I quoted from "Pacific Architect and Builder," there occur in buildings 40,000 serious accidents each year due to people walking or falling against glass. That is from an article, a reprint of which has been sent to all the registered architects in the State of New York. I appreciate your comments on it, because I can see that the 40,000 serious accidents could include bathroom glass shelves falling down and cutting your hand, etc., but I stand by my quotation. If members of the glass industry consider it serious, they ought to examine the situation and try to nullify the effect of the wide distribution of this reprint.

# Installation and Operation of Public Entrance Doors

By Ralph E. Andrews,* Factory Sales and Service Engineer,
The Alumiline Corporation

This paper will consider the criteria found to be essential to keep quality standards for public entrance doors in accord with the architect's intent, and to achieve the life expectancy which the door manufacturer has built into his product. No attempt will be made to recite the many types of doors and door materials, since detailed information of this kind is readily available in the literature published by the makers of standard products. Rather, we will examine the real causes of poor door operation. The principles to be stated apply equally to the various types of doors found on public buildings.

Some of the problems which could be avoided at the design stage are:

1) Doors which are too hard to open due to the pressure of prevailing winds or other abnormal conditions. To remedy this, canopies, overhanging roofs, and recessed entrances should be used to avoid direct exposure to the elements, especially in those areas where extremely strong prevailing winds are known to exist.

   The stack or back-draft condition which exists in some buildings can also make it difficult to open doors. When an interior arrangement such as a long corridor leading to an exterior entrance has produced a wind-tunnel effect, the use of revolving doors, balanced doors, and vestibules with double banks of swinging doors may be desirable with either automatic or manual control. When swinging doors are selected, and there is protection from direct wind exposure, the center-hung type, fitted with a floor check having two-speed control and hydraulic back check, is desirable. When hold-open is specified, it should be incorporated in the checking device, rather than in a separate unit at the top of the door which would transmit unequal stress to the door.

2) Physical injury due to people walking into large glass panes, mistaking them for doors. To avoid entrances in which doors are hard to distinguish from the adjacent glass areas, we suggest pull handles large enough to be readily seen, and shaped and/or engraved to direct the traffic flow properly. The use of color in engraved designs or words is a further help to direct people to the door. Push bars should be curved and protrude away from the door near the toe rail. This,

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together with the engraving, invites the public to push at that point rather than nearer to the heel. In addition, pushing near the toe requires less force to operate the door.

Use of dividing muntins or bars in the side lights which line up exactly with the push bar on the door should be avoided, as should built-up base rails of doors which line up with side light bases. The door can be made more recognizable by such construction as the addition of center panels, horizontal muntins, higher than normal bottom rails, and the wide-stile door.

People colliding with doors having automatic operators is another common cause of injury. Some doors with automatic operators will continue to swing after the cycle has started, even though a person is on the mat on the "in" side. In this case, the person entering from the outside is protected, since the door won't come to a sudden stop. There is available an attachment which, when applied to the interior side of the door at the bottom, will stop the door when contact is made with an object such as a toe. When the contact is broken, the door swing is resumed. The resulting action is a nudging effect to clear the person from the mat on the inside.

Other types of door operators will stop completely when contact is made by the door with an object on the mat inside. In this case, the person on the inside is protected while the person on the outside runs the risk of hitting the door, which has stopped unexpectedly. It remains for the architect and the manufacturer's representative to decide which of these types of operation would be best. The desired traffic flow and physical arrangement at the entrance will be considered in making this decision, but in any case the doors should not open too near an adjoining wall or window, nor be restricted from opening manually in the opposite direction by using permanent stops on the frame.

3) Broken door corners and weakened joints due to doors striking obstructions. Broken door corners and weakened joints may result from the use of wooden floor wedges, or from the door striking an obstruction such as a wall or railing at the end of its swing. Floor wedges must not be used; positive back-stops of the proper degree should be specified as part of the closing device.

Use of hardware which extends across corner joints leaving too little space or metal to reinforce can also cause damage. There is operating and holding hardware on the market which was originally developed for the slab-type door, and which will operate well on the installation intended. However, too many times this same hardware is specified for a narrow-line door, due to a lack of coordination between the hardware supplier and door manufacturer at the design stage. After the hardware schedules and the metal drawings have been approved, it is most difficult to make changes which will correct the error. Usually, it is better to correct problems at their source instead of making revisions to the door (such as projections into the glass light) which result in additional problems.

Failure to use hardware designed for automatic operation is another common error. The area where the power is transmitted to the door must be strong, and heavy-duty pivots and bearings must be used. Too many times it has been found that pivots designed for manual control have been used, instead of the heavy-duty pivots supplied with the automatic operator.

4) Hardware becoming loose due to insufficient door section thickness and lack of reinforcing to support fastenings. Naturally the action of thinning the door rail sections has stemmed from the need of some manufacturers to remain competitive in today's market by saving on basic material costs. There have been ingenious ways devised to do this, such as holding the standard thickness only in the particular area where screws will be located. As a safeguard, the architect should insist on adequate wall thickness. Where butt hinges are used, the butt leaves should be mortised flush into the jamb and door with separate interior reinforcing.

Violent contact with adjacent masonry wall or between doors back to back will also loosen hardware. Since it is the hardware which supplies the capability of motion to the door, the architect, in conjunction with door manufacturer and hardware supplier, should make sure that it will prevent doors from making violent contact with an adjacent wall, or with another door placed back-to-back.

5) Water infiltration into the building and ice hazard in front of doors due to failure to provide a grade away from the doors. Although it is obvious that a slight grade away from the doors to prevent water back-up and icy spots in the winter months is a necessity, it is surprising how often this is overlooked. Many times the grade is shown on contract drawings, but may be missing on the finished job, due to inaccuracies in the construction. We suggest that the architect's field inspection man should be particular on this point.

When direct exposure of doors to the elements cannot be avoided, we would recommend that a swinging door be not larger than 3' x 7' and be provided with wool pile weatherstripping installed in the door stop on three sides of the frame. When pairs of doors are used, the weatherstripping should be included between the doors. Further protection can be achieved by a recessed threshold which includes a metal stop across the opening. Sometimes we find objection to full stops on thresholds, due to a possible tripping hazard. It must be up to the architect to decide between water infiltration and the tripping hazard. In the case of pairs of single-acting doors with panic devices, the addition of a small stop on the threshold at the center point behind the doors is necessary to act as a back up for the doors, to prevent racking, and in the case of pullman-type bolts, prevent the door from being pushed in to force illegal entry.

There are also a number of common problems which could be avoided with more careful installation, such as:

1) Doors hard to open due to bindings at meeting rails, jambs, thresholds or transoms. This problem is caused by products not being installed plumb, square, and true. The contractor should clear the opening of all obstructions which interfere with the entrance, and make corrections of any masonry variations from approved shop drawings. Failure to do this might influence the installer to work around the interference, or to an out-of-plumb condition, as the course of least resistance. Wherever possible, frames should be installed after the finished floor has been poured. This will eliminate the confusion which develops when the floor is not finished in accordance with the bench marks, which should be established by the contractor. This procedure will also eliminate damage to the frame material caused by pouring of the floor and grinding of terrazzo.

2) Glass breakage due to racked or improperly glazed doors. When glazing is done by a separate contractor, the metal installer should make the final adjustments of control after glass is installed. In glazing metal doors, the glass must be cut to recommended sizes and blocked with either lead or nylon. Wooden blocking should not be used, as this material may soften from moisture. Some manufacturers install the blocks at the factory and add an adjusting screw in the top rail to square up the door. Doors glazed in this manner will not sag.

3) Locking mechanisms and panic bolts which do not engage properly and operate smoothly. When hardware is by a separate contractor, it is essential that it suit the conditions as shown on the approved shop drawings, i. e., butt hinges, when applied to a door with a beveled heel require a different degree of swagging than those used on square edged doors, to produce the proper clearances. The architect's inspector or job superintendent should never accept an entrance on which the panic devices are not operating, or are not free from binding at any point. Any faults which develop after installation may be the result of building movement, loosening of screw fastening, doors sagging due to poor glazing methods, or doors settling on hardware. A call-back by the installer three months after installation is essential to adjust for any changes which may have occurred.

In conclusion, the best protection the architect has against the trouble caused by poor door operation after the building is completed is to employ the services of companies which have demonstrated their ability for high quality workmanship on similar projects. All manufacturers maintain engineering services, and specialists are available to work with the hardware consultant as well as the architect, to aid in setting up specifications for the architect's protection. In addition, the various trade organizations have assembled a wealth of information to promote higher quality standards, which was a prime motivation for the presentation of this conference.

## PANEL DISCUSSION*

Mr. Butkis: Wouldn't the welding of the corners on aluminum doors alleviate some of the sagging?

Mr. Andrews: The only way to completely eliminate sag would be to use a solid slab-type door, or one made out of solid panels complete over the entire surface. Theoretically, this would appear to be most desirable from the standpoint of keeping the door in true plane with the frame. However, although we stress that we must have entrances installed plumb, square and true, there are always some variations which we can't control. More trouble, in some respects, is encountered on a slab-type door to make the frame and door coordinate, because in that case you have to adjust the frame out of square to match the door. Any joint, made either with a mechanical fastener or a weld fastener, does not provide a fused joint which is as rigid as a slab-type door would be. And, in some respects, it is desirable that it should not be. We have provided adjusting screws at the joint to permit angle changes to suit the particular job condition.

Mr. Muessel: Performance standards would be a better way of nailing down a door specification, rather than saying the wall thickness shall be 0.125 or 0.250, or whatever it may be. Establishing a standard for performance that any door would be required to pass would also include the application of the hardware.

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*Members of Discussion Panel listed on page vii.

Mr. Haswell: Mr. Keane, did you not mention something about performance standards in your recommendations to the industry?

Mr. Keane: Yes, that's exactly what I meant. I don't care whether they make a door out of foil or out of 3/4" bar aluminum. What I want to know, and be able to read on a test, is how many pounds of pressure applied to the corner will deflect it; how many pounds of pressure it will take to open it in a high wind; how many cycles it will function without failure. Those are the tests that I suggest manufacturers work on together, and then turn the testing over to an independent laboratory. Each manufacturer should submit his product and get testimony that it will perform in a particular manner.

I also suggest that they grade or classify their doors. We all know that there is a top quality door, a more competitive door, and a downright commercial door. These should be graded, so that the architect, the owner, or whoever buys the door can say, "If I pick this door I will get the best possible door, but I will have to pay for it." Then, when the contractor comes up with a substitution, you could look up the door and have proof that it does or does not conform to the specifications. Right now, you may submit a sample of the corner of the door, or the section of the extrusion, which may show a very nice gauge thickness, but you still don't know whether the corner can stand sufficient pressure because, even with a very heavy gauge thickness, unless the corner construction is such that it won't fail, you won't have an adequate situation.

Mr. Andrews: We in the Store Front & Entrance Division of NAAMM recognize this problem and are at the present time in the process of investigating the two major types of doors—the store front or package-type doors vs. the Class "A" doors for monumental-type buildings. The committee's ultimate aim is to have a door manual which would be available to architects and which would provide better criteria from the standpoint of performance standards.

Mr. Murphy: You gave a fair amount of attention to the automatic door. Other than one office building, I have yet to see this used anywhere except in supermarkets. Does this door have a very broad potential application?

Mr. Andrews: I personally feel that it does. I don't think that the automatic door has reached its full potential by any means. It certainly should not be restricted to supermarket buildings. From the standpoint of wind control, it has great potential, in my opinion.

Mr. Maddison: Mr. Andrews also made a statement in his presentation that the erector should adjust automatic doors after glazing. Is it not true that the door should be adjusted prior to glazing also?

Mr. Andrews: It's almost impossible to make final adjustments to such a door without the weight of the glass in it. It's true that adjustments should be made before the glass is installed, but those would be for plumbing and clearances, and those things which make the door operate without binding. But, for instance, when you have panic devices, they cannot work without coordination from the power supply. There has to be an adjustment coordinating the panic device operation with the speed and the power of the closing device, and this must be done after the full weight of the door is installed.

Mr. Neereamer: Has the industry, as a whole, given serious consideration to making available heavier sections for the framing members of doors to avoid the necessity of putting in structural steel reinforcing within aluminum members?

Mr. Andrews: We haven't done as well as we should have to establish the strength properties of all of the members and make this information available. Certainly, improvements can be made in the structural design of the aluminum extrusions. We will always find it necessary to use steel in conjunction with aluminum to some extent, and in some ways it becomes a cheaper installation to do so, but your point is well taken.

Unsigned question: Is installing hardware at the door manufacturer's plant more efficient than preparing doors for hardware using paper templates?

Mr. Andrews: Whether the hardware is installed in the factory or in the field, the basic paper template is used in either case. In the factory we can achieve greater efficiency and accuracy because we have machinery of a permanent type that cannot be taken into the field. The people we have installing this hardware are doing it continually. Our people are probably more experienced than the average man who would be installing the hardware in the field. My point is that a building in a certain area may have hardware installed by carpenters, while in another area it would be a different trade altogether. Therefore, in general, I would say factory people are more experienced than field people in installing hardware.

Mr. Muessel: We, as manufacturers, have on numerous occasions had rather sad experience with the hardware matching the templates. The template comes out and we machine the door as required for the template. Then the hardware, for one reason or another, will not fit and requires customized fitting. I am sure the same thing would apply to hardware that is field applied. As Mr. Andrews said, most door manufacturers have trained people doing this, day in and day out, who know where to make the minor modifications required to make the hardware fit.

Mr. Wright: Regarding Mr. Muessel's and Mr. Andrews' comments, we have had cases involving aluminum doors and frames where we send paper templates and later we are asked for physical samples. Mr. Muessel makes the comment that they have had occasions where the hardware did not suit the templates. That's poor coordination on the part of whoever furnished that hardware. But I don't see why it would be necessary for the aluminum door people to require both paper templates and physical samples. The hollow metal people work from paper templates and they have no difficulty whatever. I can't recall ever having a piece of hardware furnished on the job that did not meet or conform to the paper templates. When the hardware contractor issues paper templates to the aluminum door people, it is the responsibility of the hardware contractor to see that the hardware he furnishes conforms to those templates.

Mr. Stein: I respect your judgment with reference to duplication of paper templates and physical samples. However, there are occasions when a good physical sample is a necessity. It's the responsibility of the manufacturer to call on the builders' hardware supplier in this instance and explain that to do the job properly he needs a physical sample.

Mr. Wright: You are speaking, Mr. Stein, of unusual conditions rather than regular procedure?

Mr. Stein: Yes. If it's a routine matter, actually there should be no justification for a physical sample, but when you break away from routine then, based on our experience, a template is worth only so much. The physical sample covering thickness, hole drilling, tapping, finish, etc., often proves to be a necessity.

Mr. Wright: Mr. Andrews made the statement that regardless of whether you have both paper templates and physical samples, they worked first from the paper templates. Is that correct?

Mr. Andrews: The original workprints which are issued for the door are based on the paper templates. We feel we have a great deal to offer the architect when we install the hardware because, when the finished product is shipped, it is inspected in an operating manner as a double check to insure that everything is in good order. To our minds, this is the safest way to insure that there will be no further cutting required in the field, since we are talking about cutting metal instead of wood.

Mr. Wright: Maybe we are talking about two different things. I am talking about the preparation of doors for hardware where the hardware installation is made in the field. The aluminum door people's request is for physical samples, not the actual hardware to install on the doors and ship with the doors. I agree with you that probably the best job will be done if the actual hardware is sent to the aluminum people and installed and shipped with the doors.

Mr. Muessel: As a point of clarification, may I ask, is it your contention that all the hardware should be installed on the aluminum door and, if so, is it shipped installed on the door, or is it then disassembled to be reassembled on the job site?

Mr. Andrews: The hardware is installed on the door and shipped on the door as a complete package unit. In our opinion, it's most desirable to do this, and most of our customers agree. Too many times, however, it becomes a problem of expediting hardware. It isn't always available when we have to have it. With some types of hardware which we have used for a long time and have confidence in, we can cut even without a template, and the end result will be satisfactory. There are other items of hardware which we could not handle this way. Under certain conditions, we require a letter from our customer stating that if further revisions or adjustments are required in the field, they will be made at his expense.

# Weather Protection of Public Entrance Doors

By F. L. Maddison,* President
A. B. Maddison Co., Inc.

## Introduction

The subject of weather protection of public entrance doors is not particularly interesting in itself, but it is extremely important. This paper will not deal with figures and statistical information, but rather with common-sense facts representing the combined thinking and experience of many individuals. It will be broken down into five sections, namely: weatherstripping, waterproof caulking, thresholds, door clearances, and locations.

Through research, we have established that many weathering problems result from the failure of the responsible parties to take into full consideration matters which are of real importance, regardless of their apparent simplicity.

Some of our statements will repeat those in preceding papers and may be repeated in those which follow. This fact alone indicates their importance.

## Weatherstripping

Careful study has indicated that all too often excessive responsibility is placed on weatherstripping, as a result of the trend toward minimizing the vertical and horizontal lines of doors and entranceways. Indiscriminate use of double-action doors, elimination of door rabbets and/or mullions, poorly selected locking hardware, and failure to take full advantage of windbreaks and vestibules, all combine to add to the problems of weathering. Regardless of how well a unit is weatherstripped, the weatherstripping will not in itself eliminate all of the problems, although it can add greatly to the performance of doors and entranceways. When placing two doors together, or selecting hardware, careful thought should be given to the effect such actions will have on proper weatherproofing. Weatherstripping requirements should not be sacrificed to achieve a specific design or to meet a desired cost.

It is obvious that various types of doors require different types of weatherstripping. On wood doors, perhaps the most effective type is the stainless steel interlocking unit used in many of our homes. Its performance through the years has proved its effectiveness, while its popularity attests to its practicality.

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*F. L. MADDISON, Affiliated with his present company throughout his business career, assumed the presidency in 1946.

On metal doors, unquestionably the most effective weatherstripping is the nylon pile or mohair unit. Generally speaking, this material is applied directly into the reglet in the door frame member. When two doors meet without the benefit of an impost or mullion, this form of weatherstripping proves most effective. Its advantages are numerous: the cost is extremely low, it is readily available in all areas, and it is easily replaced should replacement become necessary. Neither special tools nor training is required to replace it, and its simplicity of design eliminates costly maintenance problems.

Nylon pile or mohair weatherstripping is also available for glass doors. For the most part, it is applied directly to a channel member and the channel member, in turn, is snapped onto the glass frame. The channel will, of course, vary with the door thickness. As in the case of such weatherstripping on metal doors, replacement and maintenance are relatively minor items when it is applied to glass doors in the above-mentioned manner.

A relatively new product on the market today is designed specifically for the bottoms of doors. Usually, it consists of a narrow strip of steel or aluminum attached to a small nylon pile brush, designed to run the full width of the door. Slotted holes permit vertical adjustment, so that as the brush wears down, the unit can be lowered as required. This form of weatherstripping has proven very successful, due to its low cost and ease of maintenance.

Another weatherstripping product worthy of consideration is the adjustable astragal. It is suited for either wood or metal doors, and while usually constructed of brass, is available in other finishes. It can be surface applied or made an integral part of the door itself, and can be adjusted to compensate for variances within the opening. Its design and ease of adjustment make it a most desirable unit for remedial weathering problems on existing doors and entrances.

## Waterproof Caulking

Certainly, no discussion of weather protection of public entrances would be complete without a brief analysis of the importance of waterproof caulking. Previous BRI conferences have analyzed and discussed the matter of sealant materials, and their conclusions have been recorded in NAS—NRC Pub. No. 715, "Sealants for Curtainwalls," which is available on order from the NAS—NRC Publications Office, Washington 25, D. C.

There are available today sealants adaptable to practically any material, and suitable for any climatic condition, but study reveals that many weathering problems result from inadequate or improperly applied materials. For this reason, a few do's and dont's insofar as application is concerned are listed below:

1) Do not make the mistake of using sealants to correct inaccuracies of construction or material fabrication. It is impractical to fill oversized voids, particularly at the jambs and heads, where such voids result from the failure of materials to meet properly. Experience has proven that where caulking is used under such conditions, it tends to sag, fall away, and ultimately create leaks.

2) Do not caulk normal drainage points such as weep holes, bottoms of mullions, etc. To caulk these points will trap the moisture.

3) Make certain that the waterproofing caulking is not damaged by other craftsmen or by materials, after its original application. A fracture or abrasion of the

material, regardless of how slight it may appear, can be the direct source of many weathering problems.

4) Make certain that the joint-filler materials are compatible with the sealants used. The filler materials should be untreated so that no contamination is left on the surfaces which might eventually bleed through the sealants, thereby causing them to crack or peel.

5) Perhaps the most important of all is to make certain that sealants are applied to clean, dry, surfaces. Never permit the application of bedding or sealant compounds on surfaces covered with dew or frost. Frequently, weathering problems result when panels, glass, or frames are installed into areas which have not been properly prepared to receive the sealants. If proper materials are selected and applied, many weathering problems can be completely eliminated. It is best to consult with waterproofing experts in your area and rely on their judgment whenever faced with a problem of waterproof caulking.

## Thresholds

Thresholds are often considered necessary evils, primarily designed to compensate for variances in floor materials and levels. However, properly designed and correctly installed thresholds can add greatly to the weatherproofing of entranceways. It is vitally important that careful consideration be given to this matter. The threshold should project above the floor level as little as possible. Projections are inherently hazardous since they may cause pedestrians to trip or fall. The grooves should be narrow enough so that women will not catch the heels of their shoes in them, yet wide enough to permit proper cleaning. The operation of entrance doors is often impeded because the building occupant finds it difficult to keep threshold grooves clear of small stones or other obstructions. If a threshold is to render the desired service, it must be installed in the most workmanlike manner possible. If not properly anchored, it will eventually crown-up. If not properly pointed, it will prove unsatisfactory; too much concrete will force it up, while not enough concrete will permit it to dip or dish downward. The upward action causes doors to bind, while the downward action allows unwanted drafts to enter, regardless of weatherstripping.

Thresholds must be installed so that they do not trap or act as a channeling point for water. Care should be taken that proper sized screw assemblies are used where recessed attachment holes occur in the thresholds, so that the recessed area is properly filled and the possibility of ice forming is eliminated. They should be designed, constructed and installed so that the grooves will drain properly. All in all, as much thought and care should be given to the selection and installation of the thresholds as to the actual doors and hardware. It is a mistake to use a threshold to cover inequities or inaccuracies of construction, since this precludes the intended function of the unit.

## Door Clearances

The amount of clearance will, of course, vary with the materials used, their location, type of construction, hardware employed, etc. A rule-of-thumb guide would be 1/8" minimum clearance on the jambs and heads and 3/16" clearance at the bottom. These are minimum figures and any attempt to reduce them will, in our opinion, prove disastrous. Obviously, if the clearances are too great the problem of weather-shielding becomes difficult. When door and frame units are correctly fabricated and properly installed, standard clearances can be established and maintained.

Such matters as expansion and contraction, paint build-up, etc., must be carefully considered insofar as clearances are concerned, as well as the element of human error. Suffice it to say that more exacting dimensions can be maintained in a shop, where materials are designed and fabricated under shop conditions, than under actual field working conditions.

## Location

Undoubtedly, the single most important factor in the weatherproofing of doors and entrances is location. Regardless of how well the units are designed, constructed or installed, they will fail to deliver the desired service if subjected to conditions beyond their rated capacity. All too often, the only factors considered in location of the entrance are its convenience for pedestrian traffic and its architectural appearance. Little, if any, thought is given to operational factors, which often spell success or failure for the installation.

Of equal importance with appearance and traffic direction is the consideration of prevailing winds, position of sun, use of interior exhaust systems, and natural or man-made exterior protection. Today's architectural designs emphasize the importance of doors and entranceways, and if the units are to live up to expectations, more definite thought must be given to the matter of their placement. One of the most common mistakes is to locate doors and entrances on exterior elevations so that they face directly into the "bad weather" side of the building. This, in effect, means that the doors are frequently subjected to high winds and driving storms. Consequently, the areas directly inside all too often are drafty. When this occurs, the problem of maintaining even temperatures becomes difficult.

For example, frequently commercial and office buildings constructed in suburban areas are placed on hills overlooking superhighways, open fields or adjacent bodies of water in which their architectural lines can be mirrored. Invariably, when the building is laid out, the main entrances are placed to take advantage of such exterior surroundings. The fact that they then face into the prevailing wind on the stormy side of the building is given little consideration. Those who will occupy the building usually want their reception rooms and lobbies situated so that incoming guests and clientele can enjoy the scenic views. Given proper advance planning, the doors could, of course, be located in other areas without detracting from the building. The areas considered most appropriate for reception rooms could perhaps be used for executive offices, dining facilities, and so forth, thus minimizing problems of air infiltration and temperature control.

In downtown areas, particularly where buildings occupy corner locations, the entranceways are frequently placed diagonally into the corner. The fact that it may be the windiest or busiest corner in the city is not recognized, and again, the occupants are faced with an entranceway which becomes a problem. Frequently, the placement of doors diagonally at a corner eliminates entirely the possibility of using an exterior windbreak, and minimizes the use of an interior vestibule. When these two items are not fully utilized the problems of weather protection become increasingly difficult. Doors in these locations often present a pedestrian traffic hazard, because they offer an ideal opportunity for the lazy individual to save two or three steps by cutting through, rather than going around. Many times such doors are blocked by people who desire to meet exactly on the corner, or who have stopped to talk and pass the time of day. Wherever possible and practical, the entrances should be located parallel with the walls rather than diagonal to them.

Another important location factor is the relative position of the sun. When an entranceway is incorporated into a building without regard to the early morning or late afternoon sun, it may very often mean trouble for the building occupants. As an example, consider a building constructed with a large and beautiful reception or waiting room with one wall consisting mostly of a glass and metal or wood entranceway, facing directly into the early morning or late afternoon sun. Unless sun louvers, glare-reducing glass, or other similar materials are used, the sun's rays are magnified through the glass. With the sun shining directly into their eyes, employees find it impossible to work or concentrate, and look for any excuse to escape the situation. On occasion, the air conditioning will fail to compensate for this condition, because turning the controls up to cool that area would cool other areas of the building more than desired. Here again, if more consideration were given to location factors at the outset, the problem could be avoided.

Of equal importance is the location of doors and entrances relative to interior exhaust systems. Many times, the operation and weathering of the doors is affected by such systems, particularly in restaurants, hospitals and similar buildings. When the exhausts are not operating, the doors work perfectly; however, when the exhaust fans are turned on, they often cause a stack effect within, resulting in the failure of the doors to open and close properly. Needless to say, such a condition will prevent the doors from offering maximum weather protection. But, if the matter of the exhaust and entrances are considered together, the difficulty can be eliminated. This is an extremely important matter, because very often the problem is not easily or quickly diagnosed. An owner or occupant complains that the doors do not function properly and an inspection may be made at a time when the exhausts are not in operation. Thus, the only conclusion that can be drawn is that the claimant is mistaken. Frequently, two or three inspections must be made before the nature of the problem is recognized. The condition usually can be corrected, but proper advance planning will avoid it entirely.

Wherever possible, the entrance should be set back from exterior walls rather than in line with them. Of course, this cannot always be done, but greater weather protection can be achieved if the doors are set back sufficiently. There should also be sufficient pitch to the floor construction to assure proper drainage and eliminate the possibility of snow or ice accumulation. The set-back should be of sufficient depth to permit the outward opening of the doors, so that they do not protrude beyond the face of the outside wall. Where conditions permit, set-backs should be extended, in order to permit a proper flow of traffic. When area limitations prevent the employment of a full set-back, a partial area is better than none at all. Certainly, a foot or two will not steal too much of the interior space, and the building occupants will benefit from the standpoint of overall weathering and performance.

In considering the location of entrances, one also considers the location of the hinges on the doors. It is vitally important that the doors be hinged so that they will not be affected by the prevailing winds. Hundreds of thousands of dollars are spent annually repairing and maintaining doors which have been whipped and lashed by uncontrollable winds. If the doors are permitted to swing back without restraint, all door hardware and clearances will be affected. By the same token, the weatherstripping applied to the unit can easily be damaged and rendered completely useless. If the doors are hinged with full consideration of the prevailing winds, many weathering and maintenance problems can be minimized or entirely eliminated.

Another factor in door location is to make certain that the closures and hardware are adequate for the exposure. Because a unit of hardware will work in one area, does not necessarily mean it will perform the same function in another area. Doors which are equipped with inadequate hardware cannot be expected to offer the necessary weather protection.

In designing and locating doors and entranceways, we should rely upon the services of the leaders in the industry, whether they be the manufacturer, fabricator, erector or waterproofer. Their ability, knowledge, and integrity are exceeded only by their willingness, experience and desire to offer the most authoritative service available.

## PANEL DISCUSSION*

Mr. Murphy: Have you had any experience with the use of infrared lamps for melting snow and ice in front of entrances?

Mr. Chapman: Infrared lamps are used in front of entrances in the Chicago area, particularly, and have been quite effective in keeping the sidewalks clear of ice and free of moisture during winter months. They are installed as an overhead bank of lights to reflect down on the sidewalks.

Mr. O'Keefe: Mr. Maddison's presentation stressed very heavily the recessing of entrance doors, as did Mr. Andrews' and Mr. Keane's. There appears to be a unanimous, or practically unanimous, belief that recessing is very desirable. If this would eliminate many of the hardware problems which have been discussed in the past and may be discussed in the future, is there a ready solution to this problem—is there any manner in which, perhaps, a coordinated industry effort could promote recessing of entrance doors?

Mr. Keane: I think that this conference and the published proceedings will go a long way toward achieving that goal. I made quite a point in my own paper of the importance of recesses, not only for weather protection but also for protection of the people exiting from the building, so that they can disperse within that recess and not come out abruptly and run into the people on the sidewalk.

Mr. Haswell: Are there many situations, Mr. Keane, in which it is not possible to do this?

Mr. Keane: It's a question of adequate space, and is mostly done where you have a large forecourt. Some good examples are the Seagram building and the Lever House which have 50% of the area in court and 50% in tower. In the case of most speculative office buildings, where the owner wants to make every square foot pay, you often have a difficult time selling the idea of enlarging the sidewalk by another 15'. If we had the standards that I am asking for in the form of a door manual, one of the points it should make is that it is perfectly possible to put the entrance on the building line, but it is not advisable. It might be better to sacrifice 10', let's say, in an area 30' wide, to prevent maintenance problems, law suits, etc. In the end it might even be cheaper for the owner.

Mr. Haswell: In other words, you are recommending that one of the ways in which this message could be put across is that the new door manual should stress that particular point.

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*Members of Discussion Panel listed on page vii.

**Mr. Andrews:** The very fact that related trades are interested in sitting down and discussing mutual problems is, in itself, an indication that we are looking for better coordination. The architect likes to have his own design and we, as consultants from the door and hardware industries, are in a position to save him a lot of trouble if we can properly point out the things that have been sad experiences in the past.

**Mr. Wright:** Evidently Mr. O'Keefe has had the same experience I have with hardware on exterior doors. On the exterior face of the wall, such things as overhead door holders can cause a great deal of trouble. In my own area, whenever we, as hardware consultants, look over a job with an architect, we have made it a point to suggest that, where possible, the doors be set back. If all of us, acting as consultants to the architects, try to help them with some of these problems, and get them to help us solve some of our problems, we will make more progress.

**Mr. Muessel:** One other problem that ought to be pointed out is the size of the door as related to wind pressure. Conceivably, instead of using a single 3'6" wide door, a pair of 5' doors will greatly reduce the stress thrown on the door by the wind. The architect would like, in many cases, a door through which you could almost drive a train, and yet you have people opening this door manually and trying to control it. It's just like trying to grab the sail on a sailboat—you just can't hold it.

**Mr. Haswell:** In many cases you would also have to consider the required units of exit so that your clear opening becomes a consideration as well.

**Mr. Andrews:** The width of a door is important primarily from the standpoint of the wind problem. However, the height of the door is more important from the standpoint of the function of hardware, in my opinion. I mentioned in my paper that the maximum size of a single-acting door exposed to the elements should be 3' x 7' and I really believe that is a definite maximum. We can go to a greater height, without any question, by adding these various strengthening factors, but the problem is in the deflection of the door, which is less rigid in the vertical dimension, than in the horizontal dimension. So you have two problems: the width is very important from the standpoint of wind pressure, and the height is very important from the standpoint of coordinating hardware.

**Mr. Wright:** I've always thought that the height of the door didn't make too much difference as far as the function of hardware was concerned. It has been my experience that the wider the door, the more difficulty you have in handling it—with the proper hardware. I haven't experienced any more difficulty with a 3' wide door, 8' or 8'6" high, than I have with a 3' door, 7' high.

**Mr. Stein:** It all depends on the type of door you are discussing. If you are talking in terms of a lightweight, metal frame door, this is one thing, while a heavy structural or tempered glass door is another. The basic point is that the architect seeks a certain type and size of door to satisfy a particular need for an entrance. That is the governing factor, and we in the industry must be prepared to try to satisfy this need, while at the same time establishing certain practical limitations. The best thing we can do is provide the most accurate information possible on various products and then depend on the architect to make his choice in terms of the conditions involved.

Mr. Murphy: Another factor in weatherproofing entrances is the floor mat, which is probably an operating man's problem, and not even the architect could resolve it. One of the points in favor of double entrance doors, with a vestibule between, is the possibility of placing a floor mat at that location. I am not so sure, then, that the entrance should be recessed.

A new problem as regards use of floor mats involves women's spiked heels. They have damaged or made obsolete virtually thousands of dollars worth of floor mats in the past few years. Incidentally, a link mat is the best for use as an entrance mat, because it provides for good foot-wiping and dirt and water do not accumulate on its surface. The floor mat manufacturers have tried to meet the problem of women's heels by reducing the openings between the links, but they have carried the link mat design to a point now where there are no openings, and that decreases its utility. Openings about 1/8" deep are effective and give you a chance to clean the mat and allow the soil and water to drain off.

Mr. Haswell: You said, Mr. Murphy, that you wouldn't recommend recessed entrances?

Mr. Murphy: It's a debatable point, and would depend on the local situation. There are times of the year in California, for example, where rain doesn't occur for many months at a time, and in such cases I am not too sure that recessing is desirable.

Mr. Haswell: I was wondering whether you found drainage of the recess any problem.

Mr. Murphy: It's a dirt trap even if there isn't enough water to create a drainage problem. If you do have a recess, you do not have the flexibility you might like to have from a day-to-day operating standpoint.

Mr. Andrews: Mr. Maddison mentioned the clearance of a door from the standpoint of field installation. We in the door industry are working on the preassembled principle and, again referring to the accuracy and efficiency which we can assure in the factory, we feel that we can obtain closer clearances than 1/8" on the sides and the top. There is some difference of opinion between the aluminum door manufacturers as to the standards, but, in general, we have been successful in holding to 1/16" at the head and from 1/16" to 3/32" at the heel horizontally with 1/8" in the center. These are close clearances and require close machining tolerances, but we can get these in the shop, whereas you can't do this in the field.

Mr. Wright: In speaking about thresholds, Mr. Maddison mentioned that projections should not be higher than actually necessary. Mr. Keane mentioned that on the threshold or at the center of the pairs of doors there should be some stop to keep the doors in line with the bottom. The threshold for pairs of doors, particularly on public entrances with single-acting doors, should have a stop strip to act as weather protection, as well as a stop at the bottom of the doors to keep them from getting out of line. Of course, that raises the height of the threshold, probably from 1/4" to 5/16", but it is important, particularly on pairs of doors.

Mr. Haswell: Is there any comment among the panelists about the use of a stop on the frame and/or threshold to convert what is basically a double-acting door into a single-acting door? Have any of you ever run into a case where a double-acting door hinge is used, for example, and a stop is put on to make the opening single-acting?

Mr. Stein: It is poor practice to attempt to convert a center-pivoted, double-acting door to a single-acting, open-out or open-in door, without resorting to a change in hinge, because you have definite characteristics in the hinge for that particular operation. The best practice would be to change to single-acting hinges and then apply overhead door stops, rubber mounted and rubber faced. Anything short of that will be injurious to the hinge and also to the door.

Mr. Maddison: I would like to comment on Mr. Wright's statement. There is on display here a full size mock-up that is a good example of a threshold with a very small, upstanding leg which answers this problem, insofar as keeping the doors in alignment is concerned. We are opposed to such construction, however, when they start increasing the height of the stop from 1/4" to 1/2" or more. A 1/4" height is about maximum. Beyond that you present an opportunity to the accident-prone and you're only asking for problems in the future.

Mr. Haswell: You are speaking, Mr. Maddison, of one particular type of door. Supposing you were talking about a wood door equipped with panic hardware for exit use. Does that not change the situation somewhat?

Mr. Maddison: It does not change the basic principle. You've got to keep your threshold rise, or projection above the floor, to an actual minimum regardless of the hardware, to meet the various building code requirements in different parts of the country. In Boston they are very conscious of egress as a result of the Cocoanut Grove fire. What is acceptable in one area may not necessarily be acceptable in another. I can't see where a hardware change really makes much difference in the threshold operation.

Mr. Butkis: In the case of a threshold where you use the floor closers, you can't use this type of rise effectively. It just wouldn't work out. I don't know how you could arrange to keep the snow and rain out with that type of a floor closer and center-hung, offset pivot arrangement.

Mr. Wright: I believe there is a threshold design with a continuous stop on it that can be used for center-hung doors. The threshold height, as I recall, is 3/8" and the stop is only 3/16" above that. It's a separate stop strip fastened to the top of the threshold.

Mr. Haswell: What about the clearance through the heel of the door as the door opens?

Mr. Wright: It's cut out about 2" at the back edge of the door, at the pivot point.

Mr. O'Keefe: I would like to ask Mr. Maddison a question on weatherstripping, first preceded by the observation that on some Class A construction work it appears that frames are being installed with the rabbet accomplished by means of a blade stop. Does this represent any problems with weatherstripping?

Mr. Maddison: It hasn't, to my knowledge. We have not encountered it.

Mr. Muessel: When the blade stop came out initially many of the manufacturers had no provision for weatherstripping on single-acting doors. This has now been modified by most manufacturers so that, where they use this blade stop on single-acting doors, there are provisions in the stop for a pile-type weatherstripping. There are still on the market framing moldings that do not have provision for weatherstripping, and they are of this blade stop type. The problem there is no different than it is with the old rabbetted frame that did not provide for weatherstripping. In either case, you cannot weatherstrip effectively.

Mr. Andrews: Regarding the conversion of double-acting to single-acting doors, if I were a storekeeper I would like very much to be able to do this. As far as the mechanical operation of the closer being detrimental, I am not sure it would be. From a practical standpoint, the prevailing winds in the winter time are very different than in the summer time. A very convenient method of keeping cold air out of a store would be to make the doors single-acting by the addition of a small rubber bumper in the winter, and removing it for better traffic flow in the summer, thus making them double-acting. However, there are many areas where you violate the code if you do this.

Mr. Muessel: Most of the double-acting door closers are basically two single-acting closers combined in one manner or another. Using a double acting closer in a single-acting installation does not throw any more load, or a more severe load, on the closer.

Mr. Stein: Single-acting hinges are made for single-action duty and as such, in the closing cycle, have a swing-through of about 5 degrees beyond the closed position to snug the door firmly against the stop. By using a double-acting hinge with a stop, you give up that factor, and furthermore, you have a neutral area where the double-acting hinge has been made more or less ride-free at the threshold line, so you don't get the proper hinge performance. I agree that it would be very desirable under certain circumstances, where you might not be in violation of building codes and practices, to be able to accomplish the conversion. But, in a technical sense as applied to hinges, you are not getting the best out of the hinge when you try to impose upon it a different duty than that for which it was designed.

Mr. Muessel: Many double-acting hinges or floor checks may be adjusted to put the door in a rest position beyond the stop. By using the stop and readjusting the hinge, you are creating the same thing that you have with a single-acting floor check. It comes up against the stop and, instead of that being the normal, at-rest position of the closer, it may be a few degrees beyond that, so you still have pressure against the stop. This is not true of all units, however.

Mr. Stein: Do you know of any single hinge on the market which is manufactured and recommended for that type of duty—any hinge which carries a manufacturer's recommendation that you follow this practice?

Mr. Muessel: I am not sure that anyone has it in writing in his literature, but they can be adjusted in this manner simply by turning the arm in the bottom rail of the door, as one example.

Mr. O'Keefe: As a hardware man, I have to agree with Mr. Stein, based on personal experience with heavy-duty units. In a limited usage situation, where something like that was desired, people might hazard a chance to accomplish this, bearing in mind that, if it is a failure they must pay the bill for it. We had an installation of some 40 or 50 doors where, against our recommendation, a double-acting floor hinge was used for a single-acting purpose, but before one year passed there were failures, and they continued. The manufacturer would not recommend the hinge for that use. In heavy usage, they will fall down on the job.

Mr. Haswell: It is worthy of note that none of the papers delivered at this conference, although they touched on the matter of installation, had much to say about fastenings. Mr. Keane did give one example where it might be implied that fastenings had failed, but it leads me to wonder about the way fastenings are holding up, or the importance of fastenings in the operation of public entrance doors.

Mr. Wright: We've had considerable trouble with reinforcements for hardware on aluminum doors and frames. I have seen aluminum frames backed up with steel channels, etc., but we do have trouble getting proper fastenings for door hinges, and door holders and closers. Maybe that is due to the fact that the door sections or the frame sections are not heavy enough. What is a proper reinforcement for an aluminum unit?

Mr. Muessel: In many cases steel is used as a structural reinforcing material primarily in the frame area. In many of these applications, advantage may be taken of the steel by anchoring to it the hinges or other miscellaneous hardware that connects to the frame. In the application of other hardware items, an aluminum reinforcing block, plate, or bar is used extensively, either in the door or in the frame, as a back-up for hinges, overhead closers and similar items. In other applications, the hardware throws such a tremendous load on the doors that the only solution is a through bolt such as is used in wood door construction, or a barrel nut and stud, or screwing completely through the door from the other side with a back-up plate. It varies tremendously with the particular hardware item, and the door and frame to which it is being applied. Our company may reinforce hardware in a manner different from other door manufacturers, and there are probably no two of us who do it in exactly the same manner.

Mr. Haswell: How about the fastening of the steel machine screw into the aluminum reinforcing piece? Has this given any difficulty at all where it is a heavily stressed item?

Mr. Muessel: Not if the aluminum you are tapping into is heavy enough. The threads will hold if the aluminum has adequate strength. You are not going to have a screw holding in a piece of .062, for example, but must use a thicker piece so you can get adequate threads.

Mr. Haswell: No doubt in the projected new door manual there will be some mention made of what the proper thickness of reinforcing should be, how many threads, etc., to establish a minimum holding power.

Mr. Muessel: I am sure there will be. This would be covered in a performance standard. As an example, but in a different field, the Aluminum Window Manufacturers Assn. has some specifications on anchoring of handles to windows where this is spelled out.

Mr. O'Keefe: Are all door frames reinforced for hardware in the factory, or are only the frames fabricated and then reinforced for hardware in the field? By field, I mean by a local distributor, perhaps.

Mr. Stein: Actually, the methods and systems vary greatly depending on the various manufacturers. You will find that a high percentage of frames today are factory built, and factory reinforced where needed, to beef up the connection between a transom bar and a jamb section. At least one line of frames on the market has internal steel reinforcement as standard practice. In 15 years there has not been a single failure. You can do a very creditable job with factory construction, but on the other hand, to answer your question more completely, there are many frames built in the field today from hollow tubular sections and other factory fabricated sections. In this case, the local assembler must be sure that adequate provision is made for the proper connections. Otherwise, field assembly could develop into more of a liability than an asset.

Mr. Haswell: We might ask the architects on the panel if this is not really a matter for the architect's job inspection; that is, to be sure that if there is substitution of a frame when you have, perhaps, specified a complete unit, that the frame assembled and/or reinforced in the field is equal to the one that was specified. Would that not be a matter for your job inspector to catch, Mr. Keane?

Mr. Keane: It certainly would, not only for the job inspector but for the manager who handles the job in the first place, because the general contractor is supposed to furnish shop drawings and get approval on both the frame and the door. If he bought the doors from one manufacturer and the frames from another, the shop drawings then either would not show the frames or would show the frames and have the clause "by others." The inspector would immediately recognize that this was a job homemade in the field, and should refuse to approve it.

Mr. Haswell: Would you rule out the possibility that a complete unit could be submitted on the shop drawings and then a substitute frame brought to the job site?

Mr. Keane: I would, because I must have that much faith in the honesty of the contractor.

Mr. Neereamer: It has been my experience that we do not get the kind of shop drawings that show all of the reinforcing. Furthermore, the shop drawings very seldom show the detailed method of securing the reinforcing within a tubular or an extruded section. The man in the field has practically no opportunity of seeing inside one of those sections once they are erected—it's almost an impossibility. The fastenings, at the time the door and frame are installed, are probably very secure from the appearance standpoint. It's not until 8 or 10 months later that they start loosening up, and the trouble begins. By that time, in many cases, the architect and the contractor are off the job and it becomes a maintenance problem.

Mr. Keane: As regards substitutions, I did not go into the reinforcing question, because that would be part of the manufacturers' standards that I am asking for. Those standards (and I hope the proposed manual will provide them) should say that if you have a 3' 8" door, your reinforcing should be either steel or aluminum bars allowing so many threads, and the number of threads, of course, should be equal to the tensile stress that you can put on the screw. Therefore, if we had technical criteria the architect would not have to worry whether he should use a 1/16" steel plate or 1/8" or 3/16".

Mr. O'Keefe: It is our experience that shop drawings are not always prepared by a manufacturer; rather, they are prepared in the field or in the local area by the distributor. Therefore, if the distributor does submit a drawing showing frames and doors, there is actually no real substitution, as such, because the extrusions may be exactly the same thickness and they may be the same design. However, in many cases because of expediency on the job or a competitive situation, the frames are supplied by the distributor at the one source. This distributor controls the local market place, builds his frames at the local shop, which may be a store or a little warehouse, and gets them out to the job site. As Mr. Neereamer said, there is no opportunity for the field inspector to examine the reinforcement, and in many cases that is the reason for failure on the part of the reinforcement for hardware.

Mr. Keane: If we had a testing laboratory where both the frame and the door were tested and labeled, we wouldn't have this trouble. Then, the architect or inspector could see on the job that the door had been tested, and met the requirements in the manual.

# Materials and Maintenance Factors for Public Entrance Doors

By Edward H. Stein,* Sales Engineer, Building Products Sales,
Pittsburgh Plate Glass Co.

## INTRODUCTION

Doorways in public buildings probably receive the roughest usage of any building parts. Doors, hinges and hardware are working mechanisms, and as such, are subject to all types of abuse imposed by climatic conditions and day-by-day operation. Despite these conditions, they must constantly be ready to accommodate normal and peak load traffic. As control centers for buildings, they must accommodate the traffic in a safe and expeditious manner and serve the public convenience. Entrance materials should be properly designed and durably constructed to assure their capability of withstanding rigorous use.

Proper maintenance is necessary to assure that all components will capably fulfill the purposes for which they were designed and manufactured. Most building owners recognize the need of preventive maintenance for heating or air conditioning systems, but do not plan doorway maintenance on a routine basis. With good maintenance, quality entrance materials can perform well and retain their appearance for many years. A periodic preventive maintenance program will do much to assure trouble-free operation and avoid deterioration, but no amount of maintenance will overcome basic deficiencies in materials or products.

The responsibility for maintenance of any public entrance should be under the control of one individual with assistance as required by the circumstances. Depending on the size of the building, a full-time maintenance staff might be required. However, only qualified personnel should attempt the servicing of doorway materials, especially mechanical equipment. The telephone numbers of firms engaged in the maintenance of doors, manual hinges, automatic door openers or similar mechanical products should be kept handy for emergency use as well as for preventive maintenance. Major buildings will benefit by the use of a card index system to cover the periodic maintenance of equipment or materials. The manufacturer's recommendations for care of his product, warranty information and similar matters should be a permanent part of the system.

Changing conditions that result in an increase in traffic, a different type of traffic, or other factors which affect entrances, can result in obsolescence of products or materials. When this happens, it may be advisable to retain an architect to design new entrances.

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## MATERIALS AND APPEARANCE MAINTENANCE

Generally, entrances are framed with aluminum, bronze or stainless steel and, accordingly, only the maintenance of these metals is covered here. A few of the primary characteristics are noted for those who may not be acquainted with these metals and their finishes. Finishing includes all the processes which give a metal surface its intended appearance, and also the protection of the finished surface from the influences which tend to destroy it, such as atmospheric contamination.

When it is known that entrance materials will be used in seacoast areas, and particularly where they will be subject to direct sea spray, special care should be used in the selection of metals to minimize galvanic corrosion. Commercially, it may not always be practical to confine the construction to only one type of metal and this can result in bimetal or electrolytic action, unless gaskets or inhibitive separators are used between the metals. More thorough and frequent cleaning and finishing operations are needed to combat corrosive attack where there are salty atmospheric conditions.

### Protective Coatings

The protective coatings used on entrance metals vary according to the type of metal, and local practice. A satisfactory temporary coating must afford protection, preserve the original finish, and be easily removable.

### Care During Construction, Storage and Handling

The type of temporary protection for entrance materials varies with the type and finish of the metal or other material, the nature of the installation, and local practice. However, in general, the following recommendations apply:

1) Provide temporary protection during transportation to the job.

2) Schedule materials to arrive at the job after rough construction work is done, to avoid lengthy on-site storage.

3) Avoid using wrappings which will absorb moisture during lengthy storage at site.

4) Avoid any handling which might mar the metal, wood or glass through contact with other materials or handling equipment. Use padding or other protection where required.

5) Avoid exposure to grease, dirt, dust, acids, alkalis, paints, weld splatter and other corrosive or staining substances.

6) Store in an area where the metal or glass can be properly protected from any contamination of an injurious nature. Provide a sunshade if materials are protected by strippable coatings.

7) Store in a manner which will avoid racking, twisting or other similar damage to the metal, wood or glass.

## Cleaning and Preserving Metal Finishes

Proper care during construction will minimize the amount of cleaning required at the completion of an entrance. Methods of cleaning will vary with the type of metal and finish, the type of soiling, and other factors. A good practice is to use the mildest recommended method of cleaning the particular metal. If metal parts have been grossly neglected or mistreated, more drastic cleaning methods will be required, or the services of a metal-finishing expert may be needed.

The beauty of a metal entrance can be retained for many years if a proper cleaning schedule is followed. In areas where there is a high concentration of soot, factory fumes or salt sea mist in the air, more frequent cleaning will be required to insure an attractive appearance. Following the manufacturer's recommendations with a systematic schedule will generally assure good results.

The cleaning of all types and finishes of metals is too extensive a subject for complete coverage here; however, for each type of metal there is given below a brief guide for reference.

## Appearance Maintenance

The life and beauty of entrance materials depend in great measure on periodic care and maintenance. The best results are, of course, obtained when the work is done by competent, skilled metal finishers or maintenance experts. The recommendations contained here cover only routine cleaning and maintenance. When heavy duty cleaning is required, it is advisable to consult an expert for his specific recommendations.

Best results can be obtained by following a definite cleaning schedule with the frequency depending on the type of metal, local atmospheric conditions, and operating conditions at the building. It is good practice to keep a record of the dates of inspections and cleaning work performed, as this may be helpful in subsequent work.

With specific reference to bronze, should it be necessary to perform heavy-duty cleaning work, it is advisable to call on expert metal finishers, particularly if a special finish such as statuary bronze is involved. Further, certain chemicals used in the heavy-duty maintenance of bronze involve toxic and inflammable substances. Their use must always be attended by intelligent care to avoid poisoning, burns and other damage.

## TYPES OF METALS

### Aluminum

This metal is available with several finishes and can be treated by electrolytic process or anodizing, whereby a dense protective coating of aluminum oxide is formed upon the surface of the metal. Though very thin, this coating is quite resistant to abrasion, tarnish, galvanic corrosion and atmospheric attack. To preserve the beauty and usefulness of the product, anodized aluminum should be kept clean.

Although noted for its exceptional ability to resist pitting, discoloration and wear, aluminum can be stained and its natural beauty marred by harsh corrosives or extremely rough treatment. While surface damage to the finish will not reduce the strength or life of aluminum parts, care should be used to avoid such damage.

1) Finishes

a) Mill—varies from dull gray to a silvery luster.

b) Satin—finer than mill finish and available in several grades with a metallic luster showing "grain" from smooth buffing at the factory. One grade of satin which doesn't show "grain" is caustic-etched to provide a matte or frosty-looking surface. Generally, satin finish is used for aluminum in building entrances.

c) Bright—highly polished, with more gloss than satin finish, finely buffed to a mirror-like appearance. Considerable and almost steady maintenance is required for good appearance.

2) Protective Coatings

Protective coatings for aluminum include sprayed strippable coatings, tapes, and clear methacrylate lacquers.

a) Strippable coatings—This method of protection for entrance materials is satisfactory provided the coating has been applied thick enough to be easily peeled off, and the metal will not be exposed to strong sunlight for long periods. A wood or plastic paddle or other soft material may be used for removing the coating, and a solvent for the coating can be used for any small areas where tools might not be practical. This type of protection is relatively expensive, especially where large areas are involved.

b) Tapes—As this form of protection is also comparatively expensive, the use of tapes is often limited to smaller areas where the metals might be subject to light abrasion, grinding slurries, or similar contact. However, no protection can prevent damage from abuse or poor handling of materials. Tapes should be peeled off immediately after being exposed to slurries from grinding terrazzo.

c) Lacquer—Clear methacrylate lacquer coatings help protect aluminum from atmospheric effects, from such alkalis as lime mortar, plaster and concrete, and to some extent against abrasion. However, lacquer should be regarded as an aid in preserving the surface finish rather than as a foolproof guarantee against damage during construction. It is recommended that lacquered parts be given the same care as bare aluminum to provide the best protection of the metal.

3) Cleaning

For routine cleaning, the mildest method will usually work easily and well. The methods shown below should be tried in the order named on small but different, typically soiled areas, until satisfactory results are obtained. The remainder of the metal surfaces may then be cleaned by the method thus determined.

Caution should be exercised in using stainless steel wool or abrasive waxes and cleaners, since they may alter the appearance of the finish if the metal is scoured too long or too hard. Rubbing with stainless steel wool or abrasive cleaners should always be done in the direction of the metal's grain. Special care must be taken in rubbing a caustic-etched surface which shows no direction or grain. A bristle brush is recommended for use with all cleaners on patterned surfaces.

Recommended cleaning methods are as follows:

a) Wipe with a damp cloth or wash with water containing either a mild soap or a non-etching chemical cleaner (following directions of cleaner manufacturer). Rinse thoroughly with clean water; dry. If the soiling on the aluminum contains oils or greases, it may be desirable to use a solvent cleaner first.

b) Use either a wax-base polish cleaner, a nonwax-base polish cleaner, or an abrasive wax with a clean, soft rag or pad (following manufacturer's directions), or use a mild abrasive cleaner on a damp, clean cloth; rinse well and dry.

c) If the above methods are not successful, use a stainless steel wool pad (00 size or finer) with liquid wax or one of the above cleaners. Mild steel wool can also be used; however, any remaining particles will rust-stain the aluminum and contribute to galvanic corrosion, and therefore should be removed.

With the exception of wax-base preparations, cleaner deposits should be removed with clean water followed by a thorough drying of the aluminum surfaces. Wax-base cleaners leave a thin protective coating which need not be removed after cleaning unless the part is to be lacquered. If desired, a coat of a paste or liquid wax may be applied after cleaning to facilitate later maintenance.

If the above procedures have been used, and the aluminum still looks streaked or spotted, then it obviously has been neglected or mistreated and requires more severe cleaning methods.

### Bronze

Architectural bronze is in reality a leaded brass, and the most common type of "bronze" used for building materials. True bronze, having tin as the principal alloying element with copper, is not often used in building construction by reason of high cost.

The color of architectural bronze closely resembles true bronze and, accordingly, it is commonly classified in the bronze family. Commercially, architectural bronze 280 has a nominal composition of 56% copper, 41.5% zinc and 2.5% lead, with a high bronze color. Red brass 24 has a nominal composition of 85% copper and 15% zinc, resulting in a reddish-yellow color which resembles architectural bronze.

Special alloys such as nickel silver are primarily used to obtain color effects or special qualities of strength or flexibility.

1) Finishes

a) Satin—This is the best and most suitable finish for architectural bronze. It is a refinement over a mill-scale finish, and may be obtained with a 240 grit belt, a shredded fiber wheel, a muslin wheel, or by hand rubbing the proper compound.

b) Mill-scale—This is the simplest and least expensive finish for plain bronze sections. The tool and die marks are removed with a #80 and #120 grit sanding belt, or by a canvas or felt wheel.

c) Scratch-brush—A scratch-brush finish with a fine wire wheel of brass or nickel silver wire is very attractive and is commonly used in finishing hardware.

High gloss polished finishes, and statuary or "antiqued" finishes, are not covered here as they are not used as commonly as the satin finishes. Further, special consideration is required for their maintenance.

2) Protective Coatings

The natural coloration of copper alloys when exposed to weather is a characteristic of bronze metal. Oils or wax add a rich luster and create a depth of color. Transparent coatings of natural or synthetic resins or lacquers can also be used to preserve the finish after fabrication, and sprayed, strippable plastic coatings can also be used for temporary protection. During shipment, bronze should be wrapped in waterproofed paper, taped, and protected against chafing by the use of spacers and padding.

a) Oil finish—The more popular oils for use on bronze are lemon oil, straw paraffin oil, linseed oil, and castor oil. The metal should be clean and dry before application of oil. After application, the oil should be rubbed down vigorously with a dry cloth, following the direction of the grain of finish.

b) Wax finish—Paste waxes or spray-on waxes can be effectively used to protect bronze from oxidation and handling. A clean and dry surface is required for proper application. Paste waxes should be rubbed down vigorously with a dry cloth.

c) Lacquer finish—There are several transparent film coatings of natural or synthetic resins that will preserve the bright color of bronze or brass for a year or more outdoors, and for a number of years indoors. A single spray coating of the proper thickness over clean, dry metal is generally sufficient. Manufacturer's directions should be followed.

3) Cleaning

The best results in the maintenance of bronze work are obtained when the work is done by competent, skilled bronze-finishing experts. The following instructions pertain to natural satin bronze finishes only. If a bronze entrance has a special oxidized finish, the maintenance work should definitely be handled only by a skilled bronze finisher. Many beautiful oxidized and statuary finishes have been damaged beyond repair by inexperienced workmen.

a) Lacquered natural bronze—A lacquer protective coating usually assures three to six months of service without refinishing. The life span of lacquer finishes is dependent on many factors: exposure, weather, atmospheric conditions and use. Pigmented lacquer generally has a longer life span than clear lacquer.

Under extreme exposure, where the atmosphere has a high chemical content, lacquer finishes do not prove satisfactory and will not last more than about a month before starting to become discolored and unsightly. Under such conditions, wax finishes which will darken with age are usually the most satisfactory.

The finished surfaces should be washed down once each week using mild soap and water to remove accumulated dust and dirt. A soft, clean white cloth should be used to wash and dry the surfaces, followed by application of a good grade of wax as a protective coating. (Colored cloths can discolor bronze.)

b) Unlacquered natural bronze—Wipe down all exposed metal surfaces with a soft, clean dry cloth, to remove dust. Oxidation, tarnish and other forms of discoloration can be removed by washing down the metal with thin oil mixed with a fine grade of powdered pumice (No. FF), applied with a stiff brush. Vigorous rubbing may be required, depending on the depth of discoloration, so care must be taken to maintain uniformity and to prevent bright spots. The direction of rubbing must follow same direction as the grain of finish.

Following removal of discoloration, the metal surfaces should be wiped with a soft white cloth dampened with a mixture of one part commercial-grade lemon oil and four parts paraffin oil. Paraffin #2 is recommended.

If portions that have been rubbed excessively show brighter than the surrounding area, these can be toned down by dipping No. 1 steel wool into the oil mixture and rubbing over the bright spots. Thereafter, a soft, clean dry cloth should be used to wipe down the entire door or frame, to remove excess oil.

## Stainless Steel

The words stainless or corrosion-resistant can be applied to more than 30 standard alloys and many special purpose compositions. The American Iron and Steel Institute has adopted a universally accepted number designation for the more popular alloys. Types 301, 302, 316 and 430 are the most common for architectural applications. Types 301 and 302 have excellent resistance to corrosion from exposure to the elements, as well as to a chemically laden atmosphere. Type 302 is the basic "18-8" grade, representing a composition of 17 - 19% chromium and 8 - 10% nickel. It is the grade most commonly used for architectural work.

Ease of maintenance is characteristic of stainless steel. Generally, a stainless steel entrance can be satisfactorily maintained by washing twice a year with a detergent, or mild soap, and water. This operation is much like window washing; in fact, stainless sash and trim can be cleaned right along with the glass, as they respond to the same treatment.

Mill finishes of stainless sheet and strip are specified by numbers. Thin pieces less than 24" wide are termed "strip," and have different mill finish designations than the wider sheets. The expression "satin polish" is used to describe surface finishes applied by the fabricator to make-up parts and assemblies.

1) Finishes

a) No. 2 B—Provides a bright, cold rolled finish, brighter than 2 D, but without the high luster of a polished finish. An all-purpose finish for general use, such as exterior wall panels, etc., it should be used where the surface will not be subject to heavy wear and abuse, since the finish is not easily repaired or blended.

b) No. 2 D—Affords a dull, silvery white, cold rolled surface with a matte effect. This finish should be used where a high luster would be undesirable, as on roofing.

c) No. 4—The best all-around finish for architectural use, interior or exterior. Polishing is required to obtain this finish although it is not extremely reflective. It is often referred to as a grained or satin finish, and is suitable for use where welding is required, since the weld surface can be polished to blend with surrounding surfaces.

d) No. 7—Provides a polished, almost mirror-like surface. This is the highest polish normally supplied in stainless steel.

2) Protective Coatings

The use of protective coatings or coverings on stainless steel will protect the metal during fabrication, transportation and erection. Various types of paper, adhesive paper and plastic films are available for this use as selected by the manufacturer of stainless products. These protective coverings should be applied and removed as recommended by their manufacturers.

3) Cleaning

Ordinary deposits of dirt and light greases are quickly removed with soap and water. Whenever possible, the metal should be thoroughly rinsed and dried after washing. The entrance should be washed in this manner each time the glass is washed. In the case of tightly adhering deposits of grease, oil, soot or dirt film from the atmosphere, the metal may be easily cleaned with pumice, finely bolted whiting, a household abrasive cleanser, or stainless steel polishing powder. In all cases, rubbing should be in the direction of the finish lines.

Stainless steel is very resistant to corrosion, so if one cleaner doesn't work satisfactorily the surfaces can be recleaned with another to bring back the beauty and luster of the original finish. The fact that many cleaners can be used is one of the advantages of stainless steel.

Ordinary steel wool or steel brushes should never be used on stainless steel. Stainless steel wool or stainless steel sponge, however, may be used for removing abnormal accumulations of grease or dirt, if care is taken not to scratch the finish. The entire entrance should be thoroughly cleansed with any of the cleaners mentioned above, at intervals of not more than one month; more often if required. It is important that the cleaning compound be completely removed with water after each cleansing.

Many users of stainless steel have found that waxing the cleaned surfaced with ordinary liquid or paste wax will reduce cleaning costs. Periodic waxing prevents dirt deposits from adhering to the surfaces, making it possible to wipe the surfaces clean rather than washing them.

## Wood

Entrances built of wood have proved very satisfactory when properly maintained. Many wood entrances are still in excellent condition and very beautiful, even though they have been in constant use for more than 50 years. Fine woodwork must be kept clean and waxed to protect the finish. The surfaces must be refinished occasionally to seal the woodwork from the elements. As extreme temperature and humidity changes cause considerable expansion and contraction, only the best grade of finishing materials can take the abuse satisfactorily. The manufacturers of wood entrance items can provide specific maintenance information.

## Glass

Glass has been used successfully in buildings for over 1500 years. Some of the ancient installations are still intact and their original beauty remains undiminished. The early cathedrals provide rather remarkable proof of the claim that glass is the most durable, as well as the most beautiful of man-made materials. Perhaps it is a natural consequence that many people think of a glass surface as being impervious to damage except when maliciously attacked with a diamond.

All-glass doors with rails or unit fittings on the top and bottom edges are manufactured from tempered plate glass, which has approximately four to five times the strength of normal plate glass of the same thickness. It can not be cut, drilled or altered after being tempered. Such glass should be maintained in the same general manner as plate glass used elsewhere in buildings. The aluminum, bronze or stainless steel hardware attached to the glass should be maintained in accordance with the recommended practice for the particular type metal.

With proper care during construction, and normal maintenance, glass will usually retain its sparkling appearance for many years. Despite its deserved reputation for durability, there are several ways in which a polished glass surface may be damaged. Because of its visual function, clear glass is subject to the most critical inspection of all materials commonly used in buildings. For this reason, surface damage which would remain completely unnoticed in other products may inspire serious criticism when it occurs on a window surface. Because the human eye is a remarkably sensitive comparator, even the most subtle variations in surface texture may be quite noticeable under some lighting and viewing conditions.

### 1) Recommended Protection During Construction

To minimize the chance of damage to polished glass surfaces, glazed openings should be identified with a colorful flag, festoon, or tape suspended near, but not in contact with, the glass. Tapes or banners may be attached to the sash at head, jambs or sill with a nonstaining adhesive, or by any convenient mechanical means.

It has been common practice for many years to identify glazed openings by marking or coating the glass with soap, wax, cleaning powders or other materials. This practice can lead to damaged surfaces and costly replacements. Glass should not be marked or coated partially or completely with any material whatsoever, and should be washed as often as necessary to keep it clean, especially during construction.

To keep plaster, concrete, sandblasting or welding splatter from damaging glass, a temporary impervious screen of heavy plastic or of plywood is often used successfully. Such a screen should not be in contact with the glass, however. Screens may be required outdoors as well as indoors.

It is important that glass be washed, rinsed and dried at frequent intervals, preferably with a mild, neutral or slightly acid cleaning solution. Dirt, dust, construction scum, plaster, paint splatter, etc., may thus be removed easily, promptly and completely, before they have an opportunity to establish a tight grip. Triple-F pumice and mild detergents may be used successfully if the glass is rinsed thoroughly with clear water and dried following the cleaning process. Harsh cleaners and abrasives, particularly those of an alkaline character, must be avoided. Care must be taken that gritty dirt particles picked up by soft, clean cloth do not scratch the glass.

It is good architectural practice to include provisions for glass protection and for glass cleaning in the contract specifications. These are responsibilities of the general contractor, not of the manufacturer or of the glazing contractor. The omission of these requirements is a frequent source for controversy.

2) Storage at the Site

Every reasonable effort should be made by general and glazing contractors to store glass in a dry place while awaiting installation. Low humidities and constant glass and air temperatures (above dew point) are desirable. Circulation of cool dry air over glass surfaces is advantageous. Individual lights and cases should not be handled more than absolutely necessary.

3) Surface Damage

The following types of surface damage may be encountered occasionally:

a) Wet-Dry Staining—When condensation forms repeatedly on glass surfaces and then dries, perhaps as a result of solar exposure, it is possible that the surface may be "stained." Moisture leaches free sodium and calcium from the glass surface, evaporation concentrates the solution; the precipitate tends to recombine with the surface in an irregular fashion. If a wet-dry cycle continues even for a short period of time, and part of the glass surface is "protected," stain may be detected corresponding to the shape of the protected areas, when the glass is washed and the building occupied. All materials which tend to increase the moisture in contact with the glass surface during wet-dry cycles are likely to speed the effect.

Etching, frosting, or fogging, such as caused by soap marking, by alkaline washes from masonry cleaning processes, by direct attack of fluorides in industrial atmospheres, or by concentrated alkalis, will result in similar surface damage.

b) Differential Aging—Posters, labels and slip sheets may cause damage in two exactly opposite ways. If the paper or adhesive is alkaline in character, the contact area may be attacked directly. If the paper or adhesive is neutral or slightly acid in character, it may "protect" the contact area, and permit adjacent exposed surfaces to weather or age. Though subtle, such conditions are sometimes sufficiently evident to be annoying. Irregular dirt accumulations may act as variable protective films and lead to similar difficulties.

c) Pitting—Caused by welding splatter. Usually evident in the form of small black specks.

d) Abrasion—Caused by wind-blown dirt or sand, or by improper cleaning techniques.

e) Scratches—Caused by hard, pointed objects.

f) Impact Marks or Spalling—Similar to stone bruises. Caused by a sharp blow or by improper removal of tightly adhered paint, plaster, varnish or dirt.

g) Iridescence—Caused by wet-dry staining. If the glass in question has been heat-strengthened or tempered, care should be used to differentiate between "strain pattern" and other iridescence. The heat treatment required to make tempered glass results in a specific strain pattern which might have an iridescent color and a pattern, especially under certain conditions of illumination by polarized light. This is characteristic of tempered glass and can not be considered a defect.

4) Possible repairs

If the damage is slight, there is a chance that the surface can be repaired at the job site without removing the glass from the opening. Skillful manual or power buffing with carefully selected materials may correct the trouble. In general, it is not economically feasible to remove the glass and repolish it at the factory.

## ENTRANCE COMPONENTS AND OPERATIONAL MAINTENANCE

Day in-day out satisfactory performance is the criterion for the safe, secure and convenient operation of entrance doors. Each day of operation is certain to result in wear that has an influence on the life span of the materials. Obviously, doors in certain buildings will experience several million operations yearly, while others may never reach this level during their lifetime. The frequency of inspection and maintenance should be varied in relation to the operating pace and other conditions which affect the performance of materials.

A diagrammatic chart of the components of the entrance, and an index file system, are handy means of noting the items requiring inspection and maintenance. As an example, Figure 1 shows a group of common components.

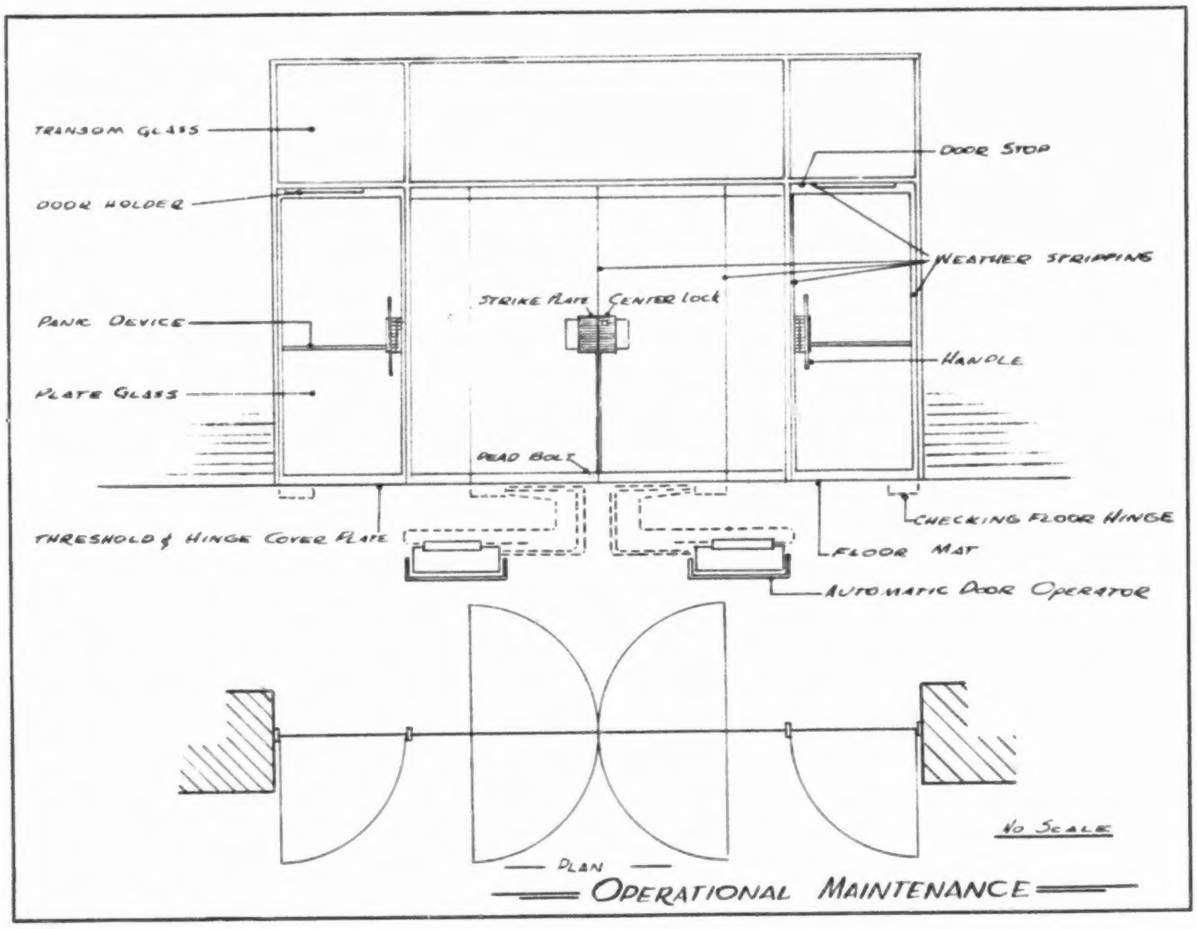
TRANSOM GLASS
DOOR HOLDER
PANIC DEVICE
PLATE GLASS
STRIKE PLATE
CENTER LOCK
DOOR STOP
WEATHER STRIPPING
HANDLE
DEAD BOLT
THRESHOLD & HINGE COVER PLATE
CHECKING FLOOR HINGE
FLOOR MAT
AUTOMATIC DOOR OPERATOR
NO SCALE
PLAN
OPERATIONAL MAINTENANCE

Figure 1

1) Doors

a) Metal frame doors—Center and offset pivot-arm hardware or butt hinges should be checked periodically to be sure doors are not binding in frame or at threshold. Any loosening of stiles and rails or racked, out-of-square condition should be promptly investigated to avoid further damage. Locks and bolts should be checked for proper operation, absence of any binding, and proper seating of latches and dead bolts.

b) Tempered glass doors—The heavy-duty construction of this type of door, with integrally applied hardware, requires a minimum of maintenance. Push-pull hardware should be checked to be sure fittings are securely tightened to the glass. Occasionally, pivot-arm hardware of hinges should be examined to be sure the door is securely mounted. If, through abuse, the edges of the doors have been badly chipped, consult a local glass firm to determine whether the doors should be replaced. Routine cleaning of the glass and metal will preserve the doors for many years.

c) Wood doors—Butt hinges or other types of hinge hardware should be checked to be certain all screws are firmly set. Locks, bolts and other hardware should be examined for proper function, and glass checked to be sure it is free of damage. The finish coatings on wood should be maintained to protect the wood against shrinkage and swelling.

d) Revolving doors—Periodically, the disk and hanger assembly, the heart of the automatic collapsible safety feature, should be cleaned. When this is done, the spring-loaded holding ball, the socket and hanger guide pins are greased, and if required, the spring tension on the holding ball is adjusted.

The revolving door speed control should also be inspected and tested periodically, the brake compartment cleaned, and the governor spring adjusted as required. The pivot bearings should be inspected for possible wear and lubricated with a few drops of oil.

2) Frames and Thresholds

a) Framing—Ordinarily, entrance frames are nonload-bearing and should not be expected to support anything more than doors, side panels and transom glass. An occasional check of all components is advisable. All loose screws should be tightened and the framing checked to see whether there has been any settlement or shifting of frame members due to extreme expansion, contraction or other causes. Any special hardware such as pivot settings or applied devices for emergency alarm or exit should be checked for proper application and performance.

b) Transom bars—When properly designed, fabricated and installed, these will require little or no maintenance except for the preservation of the metal and finish. If they develop an extreme sag, or the anchorage appears to be weak or loose, the supplier or other professional personnel should be consulted.

c) Thresholds—For safety, thresholds should be securely attached to the floor or other construction. Any loose conditions that might affect safe pedestrian travel should be promptly investigated by qualified workmen, and expansion shields and bolts regrouted in masonry floors when they show signs of being loose. This will prevent enlargement of the mounting holes.

d) Door stops—Mounting screws should be tightened occasionally and worn or damaged rubber cushioning replaced.

e) Perimeter weatherproofing—To avoid damage to interior wall and ceiling materials, an occasional check of overhead flashing and perimeter caulking is advised. Through age, caulking will deteriorate and recaulking will save damage, and perhaps high expense. The use of only the best grade of caulking is advisable.

3) Sidelights and Transom Glass

a) Sidelights and center panels—Although only limited maintenance is required, other than occasional cleaning, the glass edges should be checked to be sure they have not been damaged through abuse. Top and bottom fastenings to the setting tracks should be tightened if they become loose.

b) Operating transoms—Operating mechanism should be checked for proper movement. Powdered graphite may be used to ease the operation. Glass should be examined to be sure it is in sound condition.

c) Fixed transoms—Glass should be checked to be sure it is in sound condition, and any loose screws in stop mouldings tightened to avoid strain on glass.

4) Accessories for Doors

a) Handles—Set screws should be tightened, being sure that handles are securely set against face of glass, and that there are no sharp edges or damaged screws which might result in injury.

b) Locks and bolts—Keyways (cylinders) should be checked for ease of operation and powdered graphite applied if required. Any excessive amount should be removed to avoid soiling the clothes of the public. Strike plates or bolt sockets in floor should be cleaned out to permit proper throw of bolts.

c) Panic devices—Emergency exit doors must be in proper working order, and not "locked" with wire, rope or by similar means. All exposed screws on attachment plates should be tightened and powdered graphite applied to all exposed operating parts.

d) Weatherstripping—The success of any weatherstripping will be determined largely by the proper clearance between doors and frames. The clearance should be sufficient to permit free operation of the door without binding, while close enough to properly seal the gap. Damaged weatherstrips should be replaced and clearance reset, if required.

e) Door holders—Although overhead door holders ordinarily require little maintenance, they should be checked occasionally to be sure that arms have not been bent during a heavy wind storm, or through other abuse. An occasional lubrication of the arm will improve the operating performance.

5) Manual Checking Hinges and Closers

a) Floor hinges—Hydraulically operated floor hinges will ordinarily function well for a great many cycles without need for major overhauling. However, through such things as a severe gust of wind, the mechanism may be critically damaged. In the interest of public safety it is advisable to keep a steady check on the performance, to be certain that the opening and closing cycle is smooth and safe. The speed adjustments should be regulated for safe operation. A qualified hinge mechanic or service company should be consulted if hinges are not working properly. Oil should not be sprayed on the hinge or parts, as this will do little more than stain floor materials.

b) Overhead closers—Essentially, the operation and maintenance is the same as for floor hinges. Particular attention should be devoted to overhead closers to avoid leakage and possible staining action.

6) Automatic Door Openers

a) Electro-hydraulic—The use of qualified maintenance personnel to perform preventive maintenance and emergency repairs is advisable. Floor mats or handle controls should be checked for safe condition and proper functioning. During winter months, in the removal of ice or snow, the use of any tools or implements which might cause damage to the mats should be avoided. If automatic operators are not working, it is advisable to be sure that the power is on before calling a mechanic.

b) Electro-pneumatic—Generally, the maintenance practice is essentially the same as for electro-hydraulic hinges. Air compressors with this type of equipment require the service of a qualified mechanic.

c) Electro-mechanical—All maintenance should be referred to a qualified electro-mechanical hinge service company. However, as with any such device, it is good practice to observe the operation at frequent intervals to be sure it is operating in a safe, sound fashion. It should be ascertained that the power is on in the line to the operator before becoming alarmed over failure of operation.

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## PANEL DISCUSSION*

Mr. Chapman: Mr. Stein covered very well the recommendations for care during installation. However, I am really interested in the practical matter of achieving those recommendations on the job, and having that care maintained by all the parties concerned. Practically, it's a difficult situation. Have you any specific recommendations in this connection?

Mr. Stein: It's one thing to have proper recommendations, and another to have the follow-through. It's a matter of seeing to it that you provide, first of all, the proper know-how, the proper knowledge of the subject, to everyone who needs it, and then impress upon them the importance of protection, for their own benefit as well as yours. The simplest illustration I can provide on this point is one concerning a building designed by a leading architectural firm on which we were consulted a number of times during its planning and erection. It was a monumental job, beautifully planned and well executed. However, my first visit to the job practically floored me, because there I saw material that had come from the factory adequately protected, crates of beautiful stainless steel work, some lying against the walls, some on the floor, some splattered with plaster, being very poorly handled, being stepped upon and otherwise mistreated. It didn't take me long to get my dander up, and I think this is what we have to do every now and then. If contractors or workmen are going to abuse material like this, they must take full responsibility for it. We have an architect's representative inspect it upon arrival, and also a contractor's representative. From there on, if there is any abuse of this material, it is not our responsibility. You have to take a stand, if you find a situation of that type, and point out the importance of proper handling, which is for their benefit also.

Mr. Butkis: Much of the trouble in materials handling occurs when the material is shipped to the job too soon. Or, the contractors may insist on getting those doors up in place when they arrive. That poses a problem of how much protection will be necessary to take care of them.

Mr. Stein: The timing, or scheduling, of materials shipments is one of the most important factors in avoidance of damage. The protective coating on the metal is not going to be worth anything if heavy timber, steel and other materials are racked and thrown against it, and wet plaster and other materials spot it. This will cause damage; so the important thing is to be sure you have the proper scheduling. If you don't, you must have adequate storage space at the site so that you can avoid bringing the door right down to the entrance before you are ready to install it.

Mr. Murphy: Mr. Stein, you say, of the various materials for entrance doors, that stainless steel is preferred from the standpoint of soil resistance, stain resistance and resistance to pitting. In other words, is it the easiest to maintain from the standpoint of cleaning and subsequent maintenance treatment over the years?

Mr. Stein: Where you can afford the most expensive or exotic materials, if I can use that term, you are going to benefit because you are paying the price for certain qualities. In stainless steel you are obtaining a material that has a homogeneous structure. You are not buying just a good piece of metal with a good finish. This is not in any sense a reflection on aluminum, which would be the other white metal considered. With aluminum you obtain certain advantages which, for certain applications, may well outweigh the advantages of stainless steel. Regarding weight, this ratio must be considered as well as the cost ratio. It becomes an architectural decision as to whether one or the other will be used, but for outright, year-in, year-out permanence and durability, stainless steel is very hard to beat. The closest material to it in performance is nickel silver which, of course, is a very expensive material by contrast with the other white metals. Here you have something which is so outstanding in appearance, softness of finish, etc., that it is exceptional. Yet, in a very commercial sense, you will find that aluminum has high usage for economic reasons.

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*Members of Discussion Panel listed on page vii.

Mr. Haswell: We've dealt rather extensively with stainless steel and aluminum, but bronze is also used a great deal in entrances. Mr. Murphy, do you have any maintenance experience with bronze doors and frames?

Mr. Murphy: Bronze is a very expensive material to maintain and it's hard to keep it looking its best. The normal treatment for bronze is to wipe it off with an oil, but that entails anything from daily attention to several times a week. The maintenance operations that cost money are those that you have to do often. As a result, we use a pigmented lacquer for our bronze work, and apply it everywhere we can, except on surfaces that are handled. We try to lacquer all trim with a pigmented lacquer. Although you are limited in the extent to which you can do that, it can be done successfully. You can put plastic protection on doors where people push them with their hands, but clear plastics are most unsatisfactory because they scratch and look bad. As to the metal itself, one approach is to paint the reverse side of the plastic material, or whatever it may be, as near the color of the metal as you can. Even though the plastic will scratch, it still maintains a reasonably good surface for a considerable length of time. Bronze is almost a luxury material, though, from a maintenance standpoint.

Mr. Neereamer: I recall a job we did several years ago where, in order to achieve a white metal without resorting to specially cast and extruded aluminum sections, we used white bronze. It had a beautiful appearance, but we ran into a terrific problem in obtaining adequate working hardware in a finish which would match. We weren't able to get certain items in white bronze, so we had to resort to chrome plate on yellow bronze, which had a quite yellowish cast and was really not aesthetically acceptable. We went further than that and added stainless steel to the opening, and then we really had a potpourri of white metals.

Mr. Andrews: I was interested in Mr. Murphy's comments on the lacquer. How practicable is it to apply it on the job, and how long does it last? Is it possible to keep it in good condition and prevent peeling?

Mr. Murphy: We've had reasonably good success, but the application must be made by someone who knows his business thoroughly—it is a specialist's job. You have to clean the metal thoroughly first. The lacquer is generally sprayed on, and lasts between two and three years. If the weather exposure is not too severe, it may last longer, but that is about the limit. It is an expensive process, regardless of what it accomplishes.

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Mr. Stein: I would like to mention a fairly new development, a wax bronze finish, which has done a rather good job for us. It is brushed on the bronze, and even after handling, does not show a finger-marked appearance. This is not a lacquer; it is strictly a wax. Lacquer will not give good performance on a surface subjected to day-to-day handling. This is one place where a good wax coating, which could be maintained periodically, would be far better than lacquer. From my observation, lacquer finishes on bronze will chip or peel off quickly, especially when used on doors. This wax finish will probably outlast any of the others. The great difference between waxing and lacquering is that you can remove and renew wax very easily. Lacquer lasts a lot longer, but renewing it is another matter.

Mr. Neereamer: Through your experience have you found that some types of wax are more satisfactory for this use than others?

Mr. Stein: Yes, one particular liquid wax which is sprayed on the bronze has proved very easy to use. It was developed, I believe, primarily for metal applications.

Mr. Murphy: The best and most durable wax from the standpoint of maintenance has a base of Brazilian wax tempered with other types such as beeswax, petroleum wax, etc. The preparation with the greatest percentage of Brazilian wax base has proved to be the most durable.

Mr. Chapman: Mr. Stein mentioned the use of strippable or pressure sensitive tapes for protection. Would you care to comment on the deleterious effects of weather and sunlight on those protective media?

Mr. Stein: With the sprayed-on plastic films, we have found that unless the film has been properly applied, in the sense that a good, heavy coating has been used, you may have a difficult time removing it. This difficulty increases when it is exposed to a hot afternoon sun for a couple of weeks. The heavier the coating, the easier it is to remove. The plastic coating will adhere more tenaciously over screw heads and other such fine detail. There, after removing the bulk of the plastic by stripping it, you may have to resort to a lacquer-thinner or similar solvent to remove the remaining film over the screw heads. That is one of the problems of plastic coating as opposed to strippable tapes. The tapes cost more than the spray-on material, but, if you are not covering too large an area, they provide more positive protection in that they have a little more body than the plastic films. If you are using tapes, for example, on the bottom rails of doors, after any terrazzo work has been done, it is a very good idea to remove that tape because, through nicks, etc., you might have a certain amount of slurry splashed onto the metal and unless you remove it promptly, it will cause a corrosive acid etch on the metal which can be quite damaging. Those are the pros and cons.

# Coordinating Hardware for Entrance Doors

By J. E. O'Keefe,* President
Builders Hardware, Inc.

This paper, insofar as coordination of hardware is concerned, will be confined to construction classified by the contract hardware industry as Class "A" construction, which includes such buildings as schools, hospitals, office buildings, churches and manufacturing plants. It will not, except for background information, apply to low-cost construction such as row store buildings.

Design and construction of a building, and all the parts that make up the whole, are financed by the owner, whether private or public. Based on this accepted fact, design and construction must be accomplished in a manner that best serves the owner's interest, and this applies to the construction period as well as to the lifetime of the building. After the architect, general contractor and subcontractors have left the scene, it is the owner who will use, maintain, and require service in the proper operation of, the structure.

In order for public entrance doors to perform their assigned functions, proper operating hardware must be provided. This hardware must be correct from several points of view, all of them having a bearing on the seven design criteria enumerated in a preceding paper. The criteria that should govern the selection of operating hardware for public entrance doors are:

1) Security against unauthorized entry.
2) Ease of operation for both entrance and exit, as nearly foolproof as can be devised.
3) Durability assuring a high degree of resistance to abuse as well as to normal use.
4) Availability of maintenance and replacements.
5) Harmony of appearance with other elements of the entrance.

For those who are not completely familiar with the process by which hardware is supplied on most doors, it should be explained that the contract hardware distributor performs a comparatively unique function in this respect. He begins by consulting with the architect in the design and specification stages, sometimes writing the complete "finish hardware" division of the job specifications. When the project is released for general contract bidding, the contract hardware distributor makes an estimate of the complete job requirements for his material, and quotes the interested contractors a lump sum, guaranteed price.

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If awarded the order, the distributor then makes a complete, itemized, door-by-door schedule of the project's hardware requirements. After receiving the architect's approval, this becomes the basis on which the distributor himself, as well as allied trades, supply and locate the material. It is the document by which doors and hardware are coordinated.

Under this procedure, the role of the architectural hardware consultant becomes the key to proper selection. It may be assumed that the architect is in accord with the five criteria listed above, but his familiarity with catalog numbers and available products is seldom sufficient to permit his formulating a complete hardware specification. The consultant usually does this, or at least works closely with the architect on its composition, and upon this proper selection factor depends not only satisfaction of the criteria, but also another important consideration known as coordination of door and hardware.

Given an adequate budget, any qualified hardware consultant can provide or specify entrance door hardware which rates high in the five criterion areas enumerated. The difficulty arises when the characteristics of door and hardware are not matched, or coordinated, or when the door's characteristics fail to allow space for proper hardware to be installed.

It is my purpose to deal mainly with this problem of coordinating the hardware with the characteristics of the entrance door. For this purpose, we must consider the various materials used in entrance doors and the properties of each. I believe that present usage would produce subdivisions of entrance doors by materials as follows:

1) Wood doors.
2) Tempered glass doors.
3) Glazed aluminum doors.
4) Stainless steel doors, both glazed and solid panel.
5) Doors of ornamental metals such as bronze and wrought iron.

Of these five types, we can quickly dispose of the coordination problems in connection with four, because the characteristics of these four are such that no unusual problems of hardware coordination are presented. Hardware product design for wood doors is traditionally well adapted and requires no special accommodation other than the use of good judgment in the selection of the proper type of product to perform the function required, and to take care of any special conditions posed by the individual job situation.

Tempered glass doors are so manufactured that operating hardware must usually be factory applied. Hence it has become common practice to purchase such doors complete with hardware, so that the coordination problem (which can be quite difficult in this case) is taken care of by the door producer himself and does not become a problem for the installer or the general contractor, providing he follows good practice and the manufacturer's instructions in erecting and installing the door and its frame.

For purposes of hardware installation, stainless steel entrance doors are much like ordinary carbon steel interior doors. Consequently, the usual template procedures have proved satisfactory in the case of the stainless metal. Coordination of hardware for such openings follows along the lines of those described in "Rules of Procedure for Processing Hardware Schedules and Templates,"* with the added proviso that it is necessary for the supplier to recognize the delivery requirements, which may differ substantially from inside doors on the same project.

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*Published by National Builders' Hardware Assn., and endorsed by Hollow Metal Door & Buck Assn., Hardware Manufacturers' Statistical Assn. and American Society of Architectural Hardware Consultants.

Doors fabricated of bronze and other architectural metals are in a category by themselves. They are commonly custom-built, made to a unique architectural specification for which no ordinary procedures will serve. Many bronze door manufacturers will produce special items of hardware, particularly ornamental items to suit their own doors, and it may be that the hardware supplier will not be called upon to furnish more than the lock and the hinges. Such items are not usually a part of the finish hardware subcontract, but are purchased by the door fabricator, who consequently can insure conformance with the special characteristics of his door.

This leaves as the final and most important consideration the aluminum door. It is referred to above as a glazed door because most entrance doors of aluminum contain one or more glass panels, and this fact has a great deal to do with the proper coordination of hardware. Aluminum doors, as first introduced to the market, were special, custom-made doors for Class "A" construction; they were well designed, made of heavy extrusions and relatively expensive to purchase. As a rule, hardware for these units was supplied by contract hardware distributors as a portion of their job contract in much the same manner as hardware for steel and wood doors. On such doors it was possible to provide hardware fully in conformity with my five criteria and which, in addition, was matched with other hardware in the same building as to keying and make.

As aluminum doors increased in popularity and new producers entered the field, two trends became apparent. The first was a trend to ever narrower stiles, with the original 5" width shrinking to the present 1-3/4" dimension. The second was a corresponding tendency to lighter construction, aimed at the mass market. When these light, narrow-stile doors began to find their way into public buildings, the hardware coordination immediately became difficult. Standard hardware as provided by the producer was often inadequate because it was designed primarily for retail store front use, or because the glass distributor handling such doors, being unfamiliar with hardware, made a poor selection.

Because of the precedent established on store front work, the "easy way out" was often taken, with the result that doors, frames and hardware were included in one division of the specifications; hardware for these openings (with the exception of masterkeyed cylinders) was excluded from the finish hardware section. Worse yet, this division of the specification usually stated that doors would be "complete with hardware," or some such generalization.

The "complete with hardware" specification resulted in many problems for architects, general contractors and owners. Examples are:

1) Entrance doors equipped with dead locks, top and bottom bolts, in violation of codes or fire regulations.
2) Light weight hinges or pivots inadequate for the required use.
3) Lock units which would not accept standard masterkeyed cylinders unless field-modified.
4) Exterior doors not equipped with proper holding devices to prevent wind damage.
5) The furnishing of off-standard items with no replacements available in the event of failure.

These are only a few of the many unfortunate experiences encountered because of this "complete with hardware" generalization in the specifications. However, experience is a wonderful teacher, and some steps have been taken to ameliorate these problems. Architects have begun specifying items such as fire exit devices, door closers, floor hinges and holding devices as required to properly equip these aluminum doors for the particular locations, but even so, all has not gone well. A case in point is the fire exit device. Aluminum door manufacturers asked for and received a device that would allow the vertical rod to be concealed in a 1-3/4" wide lock stile. Due to the close tolerances involved, it is imperative that these devices be made of the best available materials; extremely close machining is required. It is necessary also to have the device installed at the time of door fabrication. Because of these factors, the concealed exit device is quite costly.

However, the best product available is none too good for a narrow-rail door! The cost of this item in many cases exceeds the actual cost of the door; therefore, aluminum door fabricators have searched for lower cost substitutes. The result has been a reduction in quality and performance below the point of acceptability. There is, for example, a well established testing procedure for exit devices known as the Accident Equipment Listing Service of Underwriters' Laboratories. It certifies that the approved devices have met the operating test designed to ensure operation under emergency conditions. How many aluminum doors are equipped with such approved hardware? Most glass distributors are unfamiliar with the UL service on accident equipment, and tend to regard all exit devices as equal, which they emphatically are not.

We have all seen entrance doors standing partly open because of wind pressure. It's not always possible to avoid such conditions when designing a building, and this problem has been solved, traditionally, by using a latching device to fasten the door in its closed position. However, narrow-stile doors prohibit the use of a latch, and are normally supplied only with a dead lock, which is no help at all when the door is in use.

At the present time, a constant battle is being waged between contract hardware distributors and aluminum door distributors for specification and control of finish hardware on public entrances in Class "A" construction, with architects and owners properly confused by the lack of understanding between the trades. Yet, both sides seem sincere in their desire to find a solution to the problem. The difficulty, I believe, is that cooperation has been lacking and coordination has not been achieved. Hardware manufacturers, for the most part, have been indifferent to the urgency of the problem and the requirements of the aluminum door manufacturers, because such requirements are decidedly different from those of the wood and steel door producers. This same indifference sifted down to hardware distributors, the attitude being, "Let them do business our way; we will not change our procedures or products." Proper coordination actually has not been given an opportunity to get off the ground.

Architectural hardware consultants are experts in their field; they are normally employed by soundly financed and managed firms with membership in the National Builders' Hardware Association. They are in a position to properly specify, sell and service contract builders' hardware regardless of the door or frame material. They are conversant with Underwriters Laboratories' accident equipment standards, building code requirements and, equally important, they know how to specify hardware that can take the abuses of operation and provide continuous safety and security. Such firms also have the inventory and trained personnel to service the hardware problems of a building after it has been turned over to the owners.

As mentioned earlier, the owner's best interests must be served and, in my opinion, this is not being accomplished at the present time. Unlike the weather problem, where everyone complains but no one does anything about it, coordination of hardware for use on aluminum doors is possible. Listed below are some very definite recommendations as to how it may be achieved:

1) A definite orientation program by the aluminum door industry directed toward "selling up" their products for Class "A" construction. Specification writers should be told that using wider stiles will accomplish the following:

   a) Allow the use of surface applied or other standard hardware, fabricated of materials heavy enough to provide proper functioning and service.

   b) Eliminate the greater part of shop installation of hardware, thereby reducing handling overhead, as most items can be installed in the field.

   c) Permit the use of heavier rails and stiles, the extra cost of which will be offset by the lower unit cost of the surface applied hardware.

   d) Simplify the problems of maintenance people at institutions throughout the country, because the same type and brand of hardware could be consistent throughout any given building or group of buildings. This would eliminate double inventory of parts, one inventory for aluminum doors and another for the balance. (Maintenance people are unanimous in asking for surface applied hardware that can be adjusted and repaired easily.)

   e) Allow the architect and owner to specify all finish hardware under one division in lieu of two, thus definitely placing responsibility for quality and service with those who thoroughly understand the product.

2) A program by the hardware manufacturers, as urged by National Builders' Hardware Association distributors, to standardize hardware for aluminum doors and hold products to the tolerances required by the aluminum door industry. Accomplishments could be:

   a) Fewer variations of products, simplifying door manufacturers' machining operations and allowing them to produce doors without fear of hidden costs for special hardware preparations.

   b) Builders' hardware distributors could specify standard hardware items and still avoid conflict with aluminum door distributors.

3) An educational program for contract hardware distributors changing the procedure in handling of hardware for aluminum doors as follows:

   a) In scheduling, separate all hardware required for aluminum doors from balance of schedule.

   b) Provide the aluminum door fabricator with complete information such as schedules and blueprint templates at an early date, prior to preparation of aluminum shop drawings.

c) Secure copy of preliminary submission shop drawings for checking.

d) Order separately and ship at an earlier date all hardware required for aluminum doors. If necessary, hold shipment of masterkeyed cylinders for field installation, as this will not interfere with job progress.

4) Form active, working committees representing trade associations and professional societies in the hardware and aluminum door industries to consolidate problems and expedite execution of solutions.

The National Builders' Hardware Association has had favorable experience in this type of coordination, having been largely responsible for the development of standard hardware preparations in the steel door and frame "package unit" field. Standard steel door producers, in defense of their products, for a time offered their units for sale complete with hardware; however, the owner's interests were sacrificed in much the same way as with the aluminum door package on Class "A" construction.

An analysis of sales and operating expenses proved to the steel door industry that the handling of hardware was bothersome, costly and adversely affected the marketing of their product. They came to the conclusion that manufacture of doors and frames was their business, not the sale of hardware.

To help overcome their problems, the National Builders' Hardware Association stepped into the picture, and effected a program through joint industry committees to accomplish a standardization program acceptable to all concerned. The result was that steel door and frame manufacturers produced and distributed their products without hardware; local contract hardware firms distributed the hardware in a completely harmonious manner, allowing the architects and owners selectivity and consistency of installation within a given structure, affording a better installation at no additional cost.

As for the "narrow sight lines" demanded by architects, there are many opportunities for designers to use glass in a building without concentrating it all in the door. Doors, especially exterior entrance and vestibule units, are hard-working members; they must be of rugged construction and the hardware must be adequate for the use intended. It is interesting to note the number of buildings equipped with narrow-stile doors where it has been necessary for the owners to have black stripes painted on the doors, or to equip them with signs reading "Door," "In," or "Out."

It is also interesting to note the number of supermarkets, schools and office buildings now using aluminum doors with wide stiles. Undoubtedly, these owners have had experience with narrow-stile doors where high frequency was involved, and have found it mandatory to change to a more durable unit with heavier hardware. The trend to wider stiles is solidly based on field experience, I believe, and needs but a small amount of cooperation to become established practice.

In summary, it will take whole-hearted cooperation to achieve the much needed improvement in coordination of public entrance door hardware. The contract hardware industry is willing to provide such cooperation.

## PANEL DISCUSSION*

Mr. Muessel: We should clarify the hardware application on the tempered glass door and on the stainless steel door. To me, a stainless steel glass door in a Class "A" installation is generally a glazed door very similar to a narrow-stile aluminum door. The hardware application on those particular items is as severe and as limiting, in some cases more so, than on aluminum narrow-stile doors. In working with the stainless steel or the all-glass doors, the areas you have to apply hardware are more limiting and in many cases provide additional difficult problems to solve.

Mr. O'Keefe: My point was that with stainless steel doors, either the narrow-stile or the wider-stile, there is no problem insofar as hardware application is concerned, because the doors are cut much like carbon steel doors.

Mr. Andrews: In my paper I mentioned that there has been a comparatively recent movement in some areas to decrease the door thickness. I suggested that the quality manufacturers have not done this to my knowledge. Now, originally I don't believe that the development of the narrow-stile door was an effort to reduce the price of the door. It wasn't necessary at that time. I am inclined to believe that the architect required the narrow sight line, and it was developed based on his request.

Mr. O'Keefe: You are right in saying that the architect did call for it. It started with the low-cost store front unit which was narrow in stile, and in many cases the narrow stile was adequate. It does a good job and it is an attractive door. However, when it comes to a public entrance door of high frequency usage, and when you increase the size of the door up to 8' and 9' high and 3' wide, you run into problems. Assume, if you will, a pair of doors leading from a school corridor to the exterior, equipped with exit devices, where feet are used to hit the cross-bars, and there is much racking and strain. It is my contention that the hardware is not heavy enough to take the abuse given to it in such locations. Therefore, heavier duty equipment should be used to take this punishment, and then you can't use a narrow-stile door.

Mr. Andrews: I'm sure you are aware that there are a lot of schools with narrow-stile doors today. As a matter of fact, my particular function for the company is to observe these doors in operation. I agree that problems can occur with doors up to 8' or 8-1/2' high or wider than 3'. I know, on the other hand, that there are some companies guaranteeing their doors for a period of years, and they do not exclude schools.

Mr. Haswell: Then it's safe to say, Mr. Andrews, that there are different quality levels in a narrow-stile door, as well as in a wide-stile door?

Mr. Andrews: Yes. As a matter of fact, I am quite convinced that some narrow-stile doors are better than others. Of course, this may be part of the problem where deficiencies have been observed. I am just trying to clarify the difference between the hardware point of view and the door point of view. When hardware people are called in to remedy a poorly operating hardware installation, their tendency is to want to put in heavier pieces of hardware. This is the position taken by Mr. O'Keefe. However, if an operational problem exists, for any reason whatsoever, then it's hard to solve in terms of heavier hardware on the narrow door, unless you change the whole door. I believe you could possibly build up any of the sections to the point where they would be very strong, but someone could still pull the hardware off the doors by stripping the screws off. In that case, the heavy duty hardware wouldn't do any good.

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*Members of Discussion Panel listed on page vii.

Mr. Muessel: To the best of my knowledge, most aluminum door manufacturers, and I am speaking of the narrow-stile door manufacturers, use panic devices that are UL tested, the same as any other panic device—not for a fire door, but for the same classification. These devices are run through exactly the same test that your wider-stile panic devices are subjected to, and they are tested in the UL facility rather than in the manufacturer's plant.

Mr. Haswell: The 100,000 cycle test?

Mr. Muessel: Yes. They are given with the UL specification which takes no account of the width of the door rail on which this panic device is to go. It could go on a slab door or on a 1" stile door. This test is run by UL in their laboratory.

Mr. O'Keefe: I haven't seen such a UL stamp or label on any of these doors. Is this a recent development?

Mr. Muessel: To my knowledge there have been UL tested or approved devices on the market for five years for narrow-stile doors.

Mr. O'Keefe: Are these manufactured by a hardware firm or by the aluminum door firm?

Mr. Muessel: Both.

Mr. O'Keefe: If they are manufactured by hardware firms, I would heartily agree that they have been tested and are so listed and stamped. Going back to my previous question referring to the panic bolts that are manufactured or supplied in the narrow-stile doors, are they stamped with labels that are identifiable?

Mr. Muessel: Yes. There may be some firms manufacturing their own devices that have not gone through this, but several that do manufacture their own devices have gone through the UL testing service in the same manner as any of the major hardware manufacturers.

Mr. Haswell: Of course, not all bolts by all hardware manufacturers bear that stamp either.

Mr. Muessel: This is true.

Mr. O'Keefe: Returing to the narrow-stile door again, particularly as it pertains to schools, Mr. Andrews' position was that his company should check on these items. I would like to point out that we, in the NBHA, had a survey taken on the same subject to check on how they are standing up. It is not at all unusual to find a school occupied for less than two years (the one year guarantee period has gone by), with a bank of eight doors only one door of which is operating. So there are failures, but perhaps not with your particular product.

Mr. Stein: It would be a mistake for us to attempt to make this into a forum on the pros and cons of narrow-stile doors, wide-stile doors, tempered glass doors, wood doors, etc., I think they all have a place. The architect certainly should exercise his prerogative in using any particular type. I am quite certain that you can buy well built, reputable, narrow-stile doors which will do a very creditable job. In my estimation, it is the job of the architect to decide on whatever door he wishes.

Mr. Haswell: I don't know that I can completely agree with you, Mr. Stein, because we stated at the outset of this session that we were devoting ourselves to doors having certain characteristics. I don't know if we can take the easy position that the architect is going to know how to specify to meet these criteria. If so, what are we doing here? We are now looking at all aspects of doors except in the area of merchandising and sales policies. We are talking about the characteristics of doors and the stile width is a definite characteristic. The hardware performance is also a definite characteristic, bearing on these criteria.

Mr. Wright: Thus far, we have talked about narrow-stile doors primarily in relation to panic bolts. My own experience has been that, with the narrow-stile door of 1-3/4", we are very limited as to the lock functions available. There are a great many cases where we cannot guarantee the owner the proper function necessary to operate his building with that type of door. The lock is not satisfactorily made to suit the requirements of the aluminum door. There is only one solution, then, and that is a wider-stile door.

Mr. Andrews: This is not the only answer to that problem. Didn't Mr. O'Keefe mention that there is a latch lock available for narrow-stiles?

Mr. O'Keefe: Yes, with one qualification. It usually comes with a knob or a pitcher handle. You are thinking of a small lever handle, are you not?

Mr. Andrews: We call it a dead-locking or a dead-latch, but in thinking of a knob set, I had reference to a full unit or a pitcher handle on the outside of the door where you can build in the various functions.

Mr. Haswell: This would be, as I understand it, a latch that, upon slamming the door, keeps it shut. Yet, this has large enough operating parts for anybody to operate it freely, at any time, without keys or gadgets. I haven't ever seen one of those on a door stile as narrow as 1-3/4".

Mr. Hettling: There is a difference of opinion here between the hardware and the aluminum door advocates. I think Mr. O'Keefe and Mr. Wright agree that the hardware distributor is a professional in builders' hardware. He does not enter into the aluminum door business. However, the aluminum door people are in both the aluminum door business and the hardware business. We, in the National Builders' Hardware Association and the American Society of Architectural Hardware Consultants, have had to meet Federal specifications, local specifications, etc., when furnishing a contract for a job. The people in the aluminum door business manufacture their own hardware in all sizes, shapes, and forms, that do not conform to any standard specification. Replacements thus become very difficult. I would like to ask the men in the aluminum door business whether they are going to have a standardization program in future years, so that the people in the hardware business can also work on the aluminum door and its hardware replacement?

**Mr. Andrews:** My company doesn't make hardware, but uses hardware made by standard hardware manufacturers. Replacement material is available and, to confirm what Mr. Muessel said, the kinds of devices that we use are Underwriters' approved. I agree that it is not possible to get the lock functions required for some types of buildings. These require a deeper back-set than the narrowness of stile would permit. But for the ordinary installation we can supply cylinders with any number of pins that they want. Now, we do have modifications to suit certain conditions, such as you suggest. The narrow-stile door doesn't have to be defined as having three sides of 1-3/4" dimension and a 4" base. It's still narrow-stile, even though we have modified it to suit certain conditions. Special doors can be made to suit certain hardware functions that cannot be contained in the usual narrow rail, or to suit certain abuse situations. This is where the engineering departments of the door manufacturers are, in my opinion, invaluable to the architect and to the hardware contractor.

**Mr. Muessel:** One of the problems that we in the aluminum door industry have faced is the indifference on the part of the hardware manufacturer and also the hardware distributor. We've been trying to get panic devices for narrow-stile doors for many years, yet it took about five years for the hardware people to recognize this need. In the meantime, several door manufacturers, because this item was not available and could not be obtained through normal channels, developed a product of their own. This would also affect the standardization which I am sure Mr. Andrews and Mr. Stein and all of the door manufacturers would like to see proceed. We have, in our narrow-stile doors, essentially the same amount of space. They vary a little bit, but the hardware manufacturers have all sorts of different sizes and we've got to achieve a meeting of the minds to accomplish the necessary standardization. I don't quarrel with the statement that the hardware people are experts in their field. But, as manufacturers, we have found that in many cases the hardware supplier is not aware of the door problem. They know the hardware problem, but it's a two-sided street, and we have been forced into becoming extremely familiar with the hardware. We could cite many instances of hardware specified by various individuals, that will not and cannot be applied to narrow-stile doors. If some of the hardware people could become more familiar with the limitations and the problems in the narrow-stile door field, this would lead to better understanding.

**Mr. O'Keefe:** I couldn't agree more with the statement you've just made. In my paper I said that coordination wasn't given a chance to get off the ground because of indifference. In looking back, I made a misstatement in my paper in that I classified all manufacturers in the same category and all hardware distributors in the same category. I would like to retract it, because there are some hardware distributors in this country who have been doing a fine job of working with the aluminum door people, and the same with some manufacturers. However, I cannot say that this cooperation is all that it should be. From the hardware distributor's viewpoint, the aluminum door people should make their needs or wants better known to the distributors. They may have given this information to manufacturers, but in the hardware industry, as I tried to point out, the distributors are the ones who are controlling the sales and the engineering of the hardware at the local level. If we can reach a meeting of the minds we will be well on our way to solving all of our problems. I am hopeful that, as a result of this meeting, by airing our problems and our views, we will reach a level of understanding that never existed before. If some of the recommendations are followed, I feel that harmony certainly is within our reach.

**Mr. Wright:** I mentioned before that we have been unable to furnish locks with the proper functions for the narrow-stile doors. In discussing this with some of the hardware manufacturers who make locks for aluminum narrow-stile doors, I understand that the sizes which they have been given by the aluminum door people will not permit them to include the desired functions. That could be a matter for cooperation between the aluminum door people and the manufacturers, to work out sizes, and problems of that nature.

# Open Forum Discussion*

Moderator—William S. Haswell, Managing Director
National Builders' Hardware Association

Howard E. Phillips, American Telephone & Telegraph Company: The speakers have mentioned many features that should be incorporated in public entrance doors. If you do all these things, can the owner afford to pay for them? Shouldn't the door be built only as well as required by the usage to which it is subjected?

Mr. Stein: I don't think we have been building in the clouds. We have been building very constructively on a sound foundation. Commercially, today, one can buy the products which we have been discussing, everything from the finest quality entrances down to the less expensive types of construction. There are any number of good quality narrow-stile and broad-stile doors on the market. There may be differences in the hardware requirements but, once again, the architect, the hardware people and the door people will have to get together and work out the problems for the specific entrance. However, we are definitely discussing products which are available today, and which are not beyond a good commercial price tag.

Unsigned question: Why don't we have better designed panic hardware, for example, the panel type of bar in place of the cross-bar type?

Mr. O'Keefe: Over the past five or six years there have been great strides in the design of panic hardware, not only on the inside but also in the many, varied trims available for the outside of the door. In answer to the second part of the question, why not use a panel in lieu of a push-bar, I believe that most building codes and fire codes read that the bar must extend at least 75% of the distance across the width of the door so that, in these cases, the panel has been outlawed. To my knowledge, the sale of that item has been going downward very rapidly.

Grayson Gill, Grayson Gill, Inc.: Reference has been made by several speakers to the effect of exhaust ventilation on entrance door operation. On what kind of building is a positive static pressure not maintained? (Modern year-round air conditioned buildings.)

Mr. Keane: For budgetary reasons very few schools nowadays are air conditioned. The only air conditioned buildings I know of are either luxury apartments or luxury offices. I also refer to the modernization program, with doors being replaced constantly, locks being reworked, yet the buildings aren't necessarily being air conditioned at that time. The percentage of non-air conditioned buildings with a negative pressure inside is higher than the air conditioned buildings with a positive pressure. Therefore, the stack effect problem does exist in a great many buildings.

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*Members of Discussion Panel listed on page vii.

Mr. Stein: You will find that even with air conditioning, as long as you have elevator shafts, stairway wells, or any opening at the top of the building in any form, there will be stack action. The higher the lobby, the greater the tendency toward stack action, so that air conditioning, while a great asset to comfort, convenience, etc., in buildings, does not necessarily nullify the situation with reference to stack action. At times it might even aggravate the situation just by the nature of the air conditioning problem as peculiar to a particular building.

A. C. King, Central Mortgage and Housing Corp.: Samples of thresholds shown by Mr. Maddison were solid metal. What type of threshold with plastic or rubber weatherstripping incorporated would you recommend as the most successful in resisting foot traffic and the effect of accumulations of ice and grit?

Mr. Maddison: I don't know the names of any particular kinds, but they must serve the purpose and serve it well, because the big chain grocery stores are using them in their enormous shopping centers. They wouldn't permit the use of it, if it were not doing a good job. They are perhaps more safety conscious, cost conscious and maintenance conscious than many other property owners.

Mr. Haswell: The questioner is from Canada and they have an unusually cold climate there. Maybe that has something to do with the question. Does anyone here know the names of several types of these thresholds?

Mr. Wright: I don't know the name of any specific type of threshold, but I imagine he means one with a vinyl insert which has become quite popular in the last few years. Our subject has been entrance doors which, in most cases, are self-closing. Wherever we have used a vinyl threshold, where there is any friction between the door and the threshold, we have found it very difficult to make the door closer function properly. You go out of the building, close the door until it reaches a certain point on the vinyl and then it will not close your door far enough to have it lock. A threshold of that kind is not very practical for a door with automatic door closers on it.

Mr. O'Keefe: We have had the same experience. However, the threshold with the vinyl insert has worked effectively without a door closer, but not in a highly traveled public entrance. It could be used on an exterior door in a school classroom or some such limited usage doorway.

E. R. Holtz, Desco Metals: Is there any justification for a door manufacturer and/or his dealer accepting compatible, name-brand "hardware by others," and then not using this, but substituting his own make instead?

Mr. Keane: The answer to the question is no. Actually, I would consider it bad faith, because the contractor does not get approval to substitute per se. He gets approval to substitute one definite product for another definite product. If he then substitutes a third product, which he did not get approval for, he is completely out of bounds.

Unsigned Question: You stated that many times the hardware was bid after other trades have made their bids. How would you explain to the entrance manufacturer how to bid his entrance when he would not know the type of hardware to be used? Some manufacturers' hardware is more difficult to install than others. I have been asked to bid on jobs where there was no tentative schedule on hardware.

Mr. Keane: This doesn't happen only in connection with hardware and doors, it also occurs in other instances. Actually, I don't think it is right to do that. In the specifications that are written for the general contractor, and from which the door manufacturer bids, we should state the type of hardware expected. We would normally mention three makes in our office, without necessarily giving the numbers, but at least giving an idea of what is expected. Otherwise, it would be quite difficult for the door manufacturer to find out how much it would cost to install the hardware.

Mr. Haswell: Do you mean, Mr. Keane, that you would specify in your hardware allowance the types of hardware that you intended to use on that door, that is, whether butt hinges or floor hinges?

Mr. Keane: Yes. If you want completely concealed hinges on wood doors for instance, surface applied or semi-surface applied, you ought to say so, since it affects the installation cost.

Mr. O'Keefe: Whoever asked that question has a very good point. Mr. Keane's method of handling his hardware is on the cash allowance basis, which is so popular throughout the country, and used by a great many architects. I believe in the cash allowance basis. However, in many of the specifications, when referring to the finished hardware division, it merely says, "General contractor will include 'X' number of dollars in his proposal to cover the cost of the hardware," and then subsequent bids are taken. This is not only true for the aluminum door people, but also for the general contractor. In the case of wood doors or steel doors, when you're using the cash allowance figures, there should be a general description or listing of items such as Mr. Keane enumerated. If floor hinges are to be provided for certain doors, they should be listed. If items like pivot-reinforcing hinges or anchor hinges are to be required, they should list those or any type of a general nature which would give the general contractor or the other allied trades an opportunity to figure their proper cost.

Mr. Neereamer: For the reason just stated, I am against the use of cash allowances for the purchase of hardware because there are too many other trades involved who, at the time they are preparing a bid, do not have the knowledge to prepare that bid properly. I try to discourage the use of cash allowances. I prefer to present definite technical specifications of the type and variety of hardware I expect to have.

W. S. Swan, Pilkington Glass Ltd.: All discussions have referred to swinging doors. Of late we see a tendency to use sliding doors. This is true especially in stores in shopping malls in some areas. Have any of the panel members any comments on this new development? Are such doors generally acceptable to building codes?

Mr. Neereamer: We are making an investigation at present to determine adequate hardware for what we consider high-frequency usage, despite the fact such sliding doors are not used often in most retail merchandising centers. They do receive severe abuse and, with a considerable amount of regret, I report that so far we have found no commercial type of sliding door hardware or sliding door that serves our purpose. I have talked with some of the aluminum door manufacturers. They are quite interested and two or three of them, at the present time, are working on developments along that line. We see a terrific future for the use of sliding doors in retail merchandising centers, to the extent that in many cases they will replace more than half of the normal complement of swinging doors. We still do not have an adequate solution to our problem of adequate hardware, however.

Mr. Stein: The use of sliding glass doors in commercial applications is a relatively new development and has largely been brought about through the mall type of construction or design. This is a new area and its potentials and problems must be explored before we can find out what the local building requirements, codes, etc., would be. I am sure much study as to what constitutes a safe and efficient sliding door, including even automated types will be done in the near future.

Mr. Wright: Mr. Neereamer, I believe, is referring to a sliding door that is probably opened in the morning and closed at night. He has talked about an area that may be air conditioned and that has a wide opening into the store or something of that kind. Would an active sliding door during the day be a practical thing?

Mr. Neereamer: I can best answer that by repeating that it would encounter severe usage, but not necessarily high-frequency usage. Normally, such doors are opened just once in the morning and closed again at night and over the weekend. However, the service they receive by untrained, unskilled personnel is very abusive. The tracks are given no care and even trucks with steel wheels may be rolled over the tracks. We have two installations where we used extruded aluminum tracks which showed signs of impending failure after only a few weeks. The tendency in these air conditioned, closed malls is to open up the entire shop front. We are looking for something that is easy to operate, something that can be handled by untrained help, something that will stand abuse and still give security when closed. These must be see-through, glazed doors. From the standpoint of tripping hazards, etc., we prefer a single track. We would like to have a by-pass stacking arrangement at the end of the track operated by means, preferably, of automatic switches. Due to certain peculiarities of design, these doors should be floor-supported rather than top-hung. These, in a nutshell, are our requirements.

Mr. Murphy: The potential of the sliding door for high-frequency usage is illustrated by the elevator door. It's not too large, but the potentials of design probably could be developed because it certainly takes considerable abuse.

Mr. Haswell: Mr. Murphy has made a good suggestion in proposing that the design of elevator by-passing, or sliding, or automatic doors be considered as a prototype for developing hardware for this type of door.

Mr. Stein: This is one way in which you can handle traffic through a sliding door. If you are thinking in terms of high-frequency rate, automatic operation is the only answer, and there are many complex, related problems which must be handled with it, such as safety and other factors.

Grayson Gill, Grayson Gill, Inc.: In the case of entrance to single occupancy buildings with receptionist in lobby, you recommended a vestibule and revolving doors. Do you mean revolving doors on the outside bank, and balanced or conventionally pivoted doors on the inside bank? I understood you to say 12 RPM for a revolving door is satisfactory, and will pass 2280 people per hour.

Mr. Keane: I did say that we should have two banks of doors, one revolving. The decision whether the revolving bank would go on the outside or the inside of the building will be determined, somewhat, by exposure to the weather of the first bank. If we used a recessed entry where the revolving doors would be out of the weather, I would prefer to see them on the outside, because they then would relieve the partial vacuum in the vestibule. If, on the other hand, we would be forced to put one bank of doors right on the building line, then I would prefer to see swinging doors on the outside because they would need less protection and fewer things would go wrong with them.

Mr. Haswell: In your original paper, you made no mention of inspection by the architect during the construction period. What do you consider to be the architect's responsibility in this respect?

Mr. Keane: I am on a New York Chapter Committee of AIA which is just publishing a paper on this subject. Basically, my position is that the architect is supposed to inspect the final product, not the method of construction, and not how the contractor arrives at it. For example, you have a lens factory and in it you have an inspector who takes the finished lenses and inspects them for refraction, for curvature and for clearness, to see if they conform to the specifications or not. The architect could do the same thing, but it would be very costly to the contractor if he came to inspect the completed building and asked to have it torn down. Also, it would be very burdensome to the owner, because he would lose a lot of time. So the architect does the best he can; he spot-checks and inspects and points out to the contractor nonconformance to drawings or the specifications.

Mr. Haswell: Mr. Keane is saying, virtually, that the architect's responsibility is only for the finished product and not how it's achieved. This, in terms of some of the discussion we've had about how doors should be made, what some of the parts and hardware should be like, etc., doesn't seem completely practical.

Mr. Keane: I would like to correct that impression. Once the architect has the qualifications or specifications for the door, he does not particularly care how the contractor protects it. We have been talking about protection today. The question was asked whether the architect couldn't put into his specifications a statement that the general contractor is to protect the aluminum from damage, scratching, slurring, somebody hitting it with a wheelbarrow, etc. I don't think it is the architect's job to do that. It's the contractor's job to build the building in accordance with the plans and specifications, and when it is finished, to demonstrate to the architect that the doors are not scratched and have no bumps in them, and that the finish is there as it is supposed to be.

Mr. Stein: I have seen many major buildings built during the past 20 years where the architect has been a frequent visitor to the site and has played an important part in backing up the contractor, to see to it that he obtains the type of building he designed and wrote into the specifications.

Mr. Keane: We engage a staff of some 17 inspectors who do nothing else but go out on jobs and ride herd on the contractors, but in principle, we say we are not supposed to do it. In principle, if the contractor does not protect the aluminum doors, he is still responsible, at the end of the job, for having them anodized and in perfect shape. At the same time, we know it will take a long time to correct any errors the contractor makes, and therefore the owner, to whom we owe first allegiance, will suffer. We try to avoid as many difficulties as possible.

Mr. Maddison: Unfortunately, many people today who call themselves contractors are nothing more than brokers or agents, and unless your specifications are quite clear, the general contractor takes a "so what" attitude. He will see a condition develop around an aluminum or stainless steel door or other valuable item, and he will say, "We'll have the plasterer fix that, he's at fault." Then, it becomes a problem for the architect, the owner and everyone else because they have to arbitrate the dispute. If the specifications at the outset were rigid, and if it was clearly and distinctly established that the final cleaning and the protection of the materials was the responsibility of one party, namely the prime contractor, even though he is an agent on the job, he would take the necessary steps to prevent the damage, rather than try to take corrective measures later.

Mr. Keane: That's a good point and it probably ought to go into the guide that I hope the NAAMM will prepare. Here is an illustration of why we are against specifying what the protection should be. There was a case where the architect specified that as soon as the aluminum entrance door frames were up, the contractor was to put plywood around them for protection. He did. Then, when the plasterers came on the job, they promptly nailed the scaffolding up against the plywood, running right through into the aluminum. To make things worse, the contractor claimed that it was the architect's fault because, if he hadn't specified the plywood, no one would have nailed into it.

Mr. Wright: Mr. Keane, isn't the architect's responsibility primarily to the owner, to see that he gets the building that was specified? You mentioned employing a force of 17 inspectors who would have to be on the job practically all the time. There are so many hidden things in the building, not just doors, but other things, that they would have to see as they went along. to ascertain whether or not they conform to the requirements. I should think that your responsibility is to the owner and not to the contractor.

Mr. Keane: That's exactly what I'm trying to point out. On inspection of anchors for door bucks, for instance, should the architect check the reinforcing? He won't. As soon as the back wall is up behind it, you can't see it. The same is true of the anchors. The manufacturer of the frames may deliver the anchors to the job, but since they don't work with the brick coursing, the mason just throws them away. The inspector will try to catch it, but he can't be everywhere at the same time. Therefore, in the end, it is still the contractor's responsibility to deliver the product that he contracted for.

## SUMMARY

### By William S. Haswell

To summarize the points made during this conference, we first set out to answer the question, "How can we achieve a public entrance doorway that fully meets the criteria?" I believe that we all agree on the following points:

1) We need to study the entrance doorway in an effort to minimize the problems.
2) We need to consider the building's function and the usage of the specific doorway in the design and selection of materials.
3) We need to provide security against unauthorized entry, except in certain specified situations.
4) To give satisfaction, the durability of the entire assembly must be of a heavy duty nature.
5) The operation must be obvious, simple and free from accident hazards.
6) The budget assigned must be adequate to provide satisfactory public entrance doors, since low-cost units are not recommended in these locations.

There are also certain points that still seem to be somewhat in controversy, although by this discussion we have, perhaps, come closer to agreement on some of them. For instance:

1) The responsibility for poor results in an entranceway is variously attributed to the architect, the contractor, the door manufacturer, the installer, the hardware supplier and the maintenance people. Undoubtedly, we could spread the blame for a defective doorway among several of these, and in some instances among all. We are not, of course, in complete agreement in this area.

2) A more specific problem arises when doors are installed out of plumb, not truly aligned. Is this poor product design, or is it faulty installation? We didn't fully agree on that point.

3) On the operating hardware question, we did not agree as to whether, on aluminum doors, it should be provided by the door producer, or the finish hardware subcontractor. We are closer to agreement on that point, but certainly we have divergent points of view at the present time. It will take a lot more study and understanding of all the problems involved before we agree on this.

Now, as to the future, it would appear from information that the committee gathered, that we will have, as time passes, more and better automatic operating doors. Mentioned as a device is the proximity switch which, I am told, will shortly be coming into greater use in connection with automatic operating doors. But, regardless of future technical developments, I believe that there will be great advances in this field, and that doors will be used in many more locations than they have been in the past. As a result of this conference, and other contributing factors, better coordination of door and hardware components will be achieved in the field of public entrances. New and more durable finishes for the surface of doors, frames and hardware are clearly on the horizon. These are now being developed—the harder lacquers, the harder finishes, etc. These are things that everyone wants and I am certain with this concerted effort we will achieve them.

Finally, the big problem for the future, one that we have not dealt with in depth but that, perhaps, underlies all of the comments made and all of our thinking, is the eternal problem of how to obtain better quality when all forces are directed toward obtaining lower price. This is a problem that is basic to the entire field of building materials. With the pressure for lower prices, can we hold the line on quality? When an owner wants quality, when an architect wants quality, can we get it under our competitive bidding system? There is no easy answer to that question. It can be done, but in many cases and perhaps the majority of cases, it is not being done. This, perhaps, is the problem to which all of us in the construction field should devote considerable thought and energy in the years ahead.

# ATTENDANCE AT THE BRI 1961 SPRING CONFERENCE

The attendance list which follows includes all persons attending the BRI 1961 Spring Conferences, including the conferences on:

Intersociety Reports on Plastics in Building Activities
Adhesives and Sealants in Building: Selection and Field Application, Pressure Sensitive Tapes
Requirements for Weatherproofing Thin Shell Concrete Roofs
and
New Building Research, Spring 1961

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